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THE CIRRIPEDIA (CRUSTACEA) COLLECTED BY THE "FISHERIES STEAMER METEOR" IN THE EASTERN ATLANTIC [1]

(With 36 figures)

PAULO S. YOUNG
Museu Nacional
Universidade Federal do Rio de Janeiro

The German "Fisheries Steamer Meteor" made numerous dredges off the European and North African coasts between 1966 and 1975, specifically of the submarine seamounts, Josephine and Meteor, and the Azores region. Samples were collected from the continental shelf to the abyssal plain.

Cirripedia from these depths were sampled previously by the research vessels "Talisman" and "Travailleur" and by "S.A.S. le Prince de Monaco" (AURIVILLIUS, 1898; GRUVEL, 1902a; 1920).

The present study describes the species collected during the F.S. "Meteor" expeditions and reviews previous taxonomic studies as they relate to the species collected during these expedition. Specimens of *Trianguloscalpellum darwinii* (Hoek) collected during the Pulse expeditions along the Californian coast by the Scripps Institution of Oceanography were also included in this study. In addition, diagnoses and redescriptions of some species of *Trianguloscalpellum* Zevina from the Eastern Pacific are given for comparison with the Atlantic species. The distribution of the species along a depth gradient is discussed.

The specimens studied are deposited in the Senckenberg Museum, Frankfurt (SM - unnumbered), National Museum of Natural History, Washington (USNM) and Museu Nacional – Rio de Janeiro (MNRJ). Some specimens from the collections of the Scripps Institution of Oceanography, La Jolla, Benthic Invertebrates (SIO), Natural History Museum (British Museum), London (BM), and the California Academy of Science, San Francisco (CAS) were examined and compared with these previously described species. Abbreviations: spec (specimen).

Suborder Lepadomorpha Pilsbry, 1916
Family Oxynaspididae Gruvel, 1905
Genus *Oxynaspis* Darwin, 1852
Oxynaspis patens Aurivillius, 1894
(Figs.1a-e, 2a-h, 3)

Oxynaspis patens Aurivillius, 1894:38, pl.III, figs.1-2, pl.VI, figs.13-15; pl.VIII, fig.9.

Oxynaspis patens: TOTTON, 1940:476, fig.16; PILSBRY, 1907a:79; WEISBORD, 1979:39, pl.3, figs.6-9; ZEVINA, 1982:36, fig.26.

Material – Eastern Atlantic. 30°01.5'N, 28°30.0'W, 288m, 170+spec, SM; 36°36.7'N, 14°14.0'W, 300-170m, 1 spec, SM.

Description – Capitulum triangular, covered by numerous cuticular spines (Fig.1). Plates white, thin, with few growth lines and conspicuous rounded elevations located beneath base of spines; plates covering whole capitulum except for a space between carina and scutum, which enlarges during capitulum growth.

Tergum (Fig.1) triangular, occludent margin slightly convex, basal margin straight, carinal margin convex at lower half and straight at upper half. Apex slightly recurved.

Scutum (Fig.1) quadrangular, carinal margin during development varies from approximate and convex in smaller individuals to irregular in larger ones. Occludent margin nearly straight, umbo central; basal and tergal margins straight.

Carina (Fig.1) angular, umbo nearly central, tectum regularly curved.

Peduncle (Fig.1) about 2/3 length of capitulum, covered by large cuticular spines; base attached to a cup formed by the host black-coral (Fig.2a).

Labrum bullate (Fig.2b) with one row of small teeth. Palp acuminate, (Fig.2b) short, covered by long simple setae. Mandible (Figs.2c-d) with 5 teeth and acute denticles confluent with lower angle. Maxilla I (Fig.2e) with conspicuous notch; upper angle with 2-3 large spines, below notch with 7-9 median spines. Maxilla II (Fig.2f) quadrangular, with numerous simple setae.

Cirrus I (Fig.2g) with shorter ramus 2/3 length of longer, and numerous simple setae along lesser margins; articles of shorter ramus slightly protuberant. Cirri II to VI with subequal rami, length of median articles 3 times the width, 4 pairs of simple setae on anterior margin and 1-3 setae at

[1] Received on November 18, 1997. Accepted on June 16, 1998.

postero-distal angle (Fig.2h). Penis short, covered with thin setae and a tuft at its distal end.

The specimens varied from small to 9mm in total length (capitulum length 5.8mm).

Remarks – *Oxynaspis patens* was first reported from Anguilla Island, Antilles, between 125-355m (AURIVILLIUS, 1894). TOTTON (1940) noted that this species only has a reduction in the development of the carinal margin of scutum, instead of a generalized reduction of all the plates. This type of scutal development is apparent in the numerous specimens I examined (Fig.1).

These specimens, despite being smaller than those reported by TOTTON (1940), are conspicuous on the host, because of the white color of the plates in contrast with the brownish color of the antipatharian. Some specimens of *O. hirtae* usually have the same color as the antipatharian, which makes their presence difficult to detect (LETA & YOUNG, 1996).

Otherwise, this species induces a change in the antipatharians growth, forming a small cup where the cirriped attaches (Fig.2a).

I am unable to determine whether the cuticular spines of the capitulum are from the black-coral or from the barnacle. When the surface of the capitular plates are scraped the spines appeared to be from the black-coral. However, the small calcareous elevations on the capitular plates may develop in response to the coral. As the plates grow beneath the spines their margins deposit a thicker calcareous layer under the spines, forming the rounded elevations, which subsequently come to be in the middle of the plate.

The presence of this species in the northeastern Atlantic extends significantly its distribution (Fig.3) from the Western Atlantic (Anguilles and Bahamas) (AURIVILLIUS, 1894; PILSBRY, 1907a) to the Eastern Atlantic.

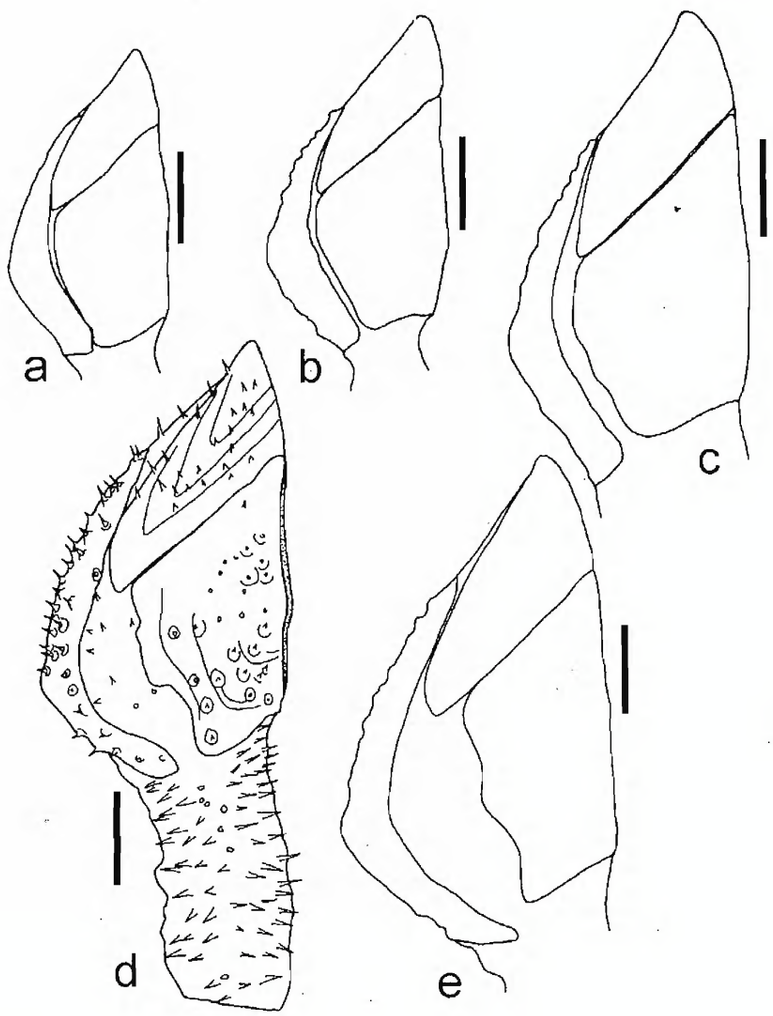

Fig.1- *Oxynaspis patens* Aurivillius (St. 19-129, AT96): a-e) lateral views of different development stages. Bar: 1mm.

Family Poecilasmatidae Annandale, 1909
Genus *Poecilasma* Darwin, 1852
Poecilasma aurantia Darwin, 1852
(Figs.4a-b)

Poecilasma aurantia Darwin, 1852:105, pl.II, fig.2.

Poecilasma kempferi aurantium: GRUVEL, 1902a:31, pl.IV, figs.1-2; 1905:115, fig.129; WELTNER, 1922:79.

Poecilasma kaempferi aurantia: ZEVINA, 1982:98, fig.86m.

Material – Eastern Atlantic. 29°59.5'N, 28°23.0'W, 303-333m, 20 spec, SM; 29°55.5'N, 28°30'W, 288-293m, 1 spec, SM; 29°49,5'N, 28°19,5'W, 311-322m, 8 spec, SM.

Description – Capitulum (Fig.4a) swollen, nearly equilateral. Scutum with longitudinal striae, irregular growth lines, and two ridges. Apico-basal ridge conspicuous, forming an occludent area narrowing toward base of plate, and with a convex occludent margin; in lateral view, this ridge arises at 1/5 height of scutum. A second ridge, usually conspicuous, present from tergo-carinal angle to basis of scutum, separating the plate into tergal and carinal areas, the latter with its surface more curved than former.Umbo basal, pointed. Basal margin short, less than 1/2 length of tergum, oblique. Internally, with a basal margin rim and low tooth (Fig.4b). Tergum apically acuminate, all

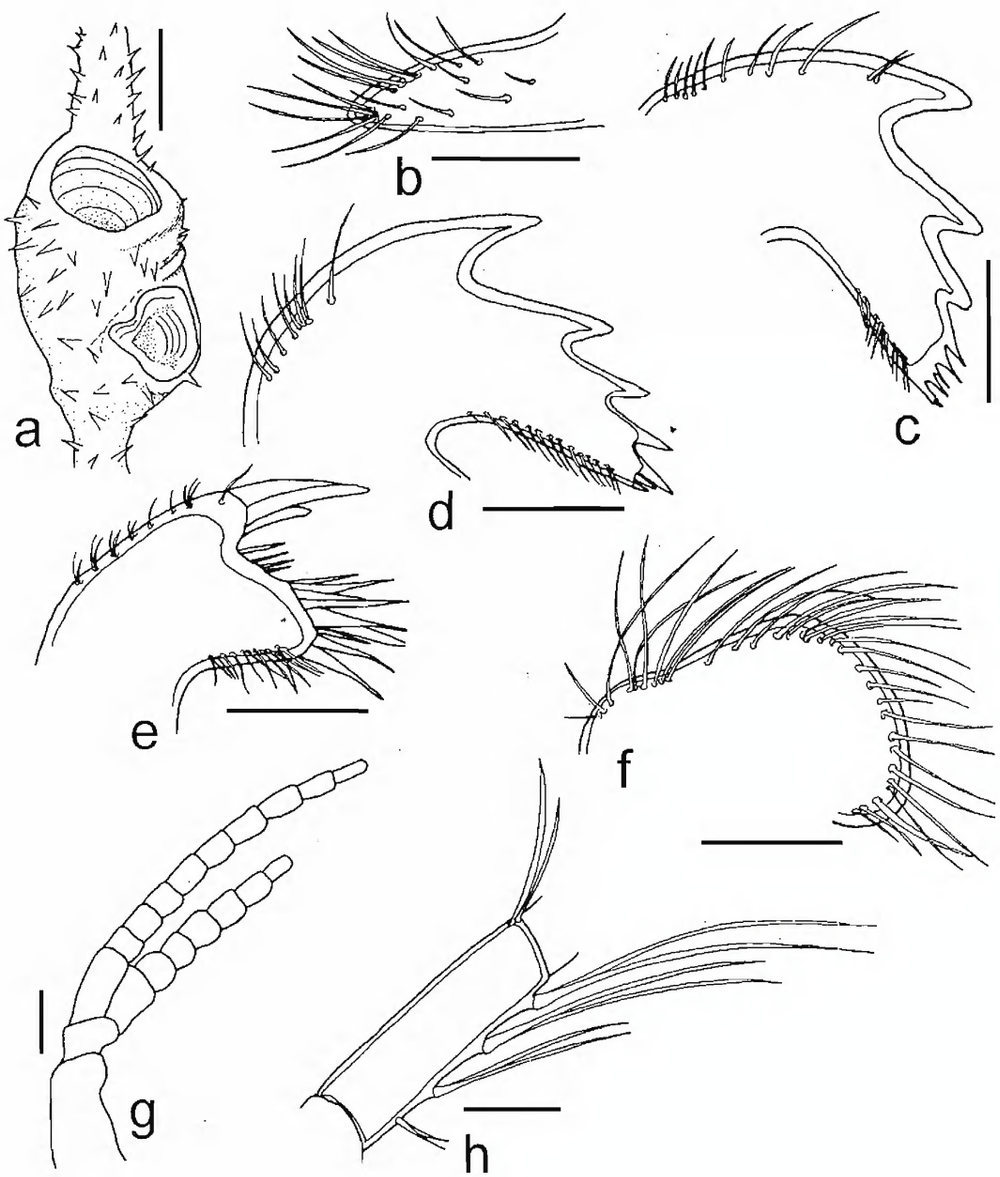

Fig.2- *Oxynaspis patens* Aurivillius (st. 19-129, AT96): a) two cups formed by the black-coral, b) palp, c-d) mandibles of the same specimen, e) maxilla I, f) maxilla II, g) outline of cirrus I, h) median article of cirrus VI. Bar: a) 1mm; b-f, h) 0.1mm; g) 0.2mm.

margins straight, carinal margin less than 1/2 length of occludent margin, oblique in relation to occludent margin. Carina short, reaching carinal end of tergum; expanding laterally to basis. Tectum flat, width equal along its length or slightly larger at apex.

Peduncle less than 1/4 length of capitulum.

The specimens ranged from 7 to 13.3mm total length and capitulum length from 6 to 9mm.

Remarks – The identification of species within this genus poses problems largely because most of the species do not have readily diagnostic characters. DARWIN (1852) described *P. aurantia* from Madeira and noted it was closely related morphologically to *Poecilasma kaempferi* Darwin, 1852, from Japan. Many of the differences are difficult to visualize, and GRUVEL (1902a; 1905), WELTNER (1922) and ZEVINA (1982) considered both as subspecies, while other authors (ANNANDALE, 1909; NILSSON-CANTELL, 1921; BARNARD, 1924) considered them synonymous. The nearly equilateral valves, the shape of the scutum and tergum and probably the differences in size of the peduncle may justify theseparation of both species. Therefore, herein I maintain the specific status of *P. aurantia*. A revision of *Poecilasma* is needed to identify how many species in *Poecilasma* are valid. All the records of *P. aurantia* are from the eastern Atlantic, but within this area there are also many records of *P. kaempferi*, which further serves to complicate their status.

The specimens examined herein agree with Darwin's description, except he did not mention the presence of a ridge extending from the tergo-carinal angle to the base of the scutum. This ridge is usually conspicuous in the present material.

The only other species reported to have this ridge is *P. kaempferi novaengliae* Pilsbry, 1907. PILSBRY's (1907a, pl.VI, fig.13) figure of this specimen is similar to the one I examined. But, when examining the type, I observed that this subspecies was based on a small specimen and this ridge is not as conspicuous as it appears in his figure. Therefore, it is difficult to decide if this species is a synonym of *P. aurantia*.

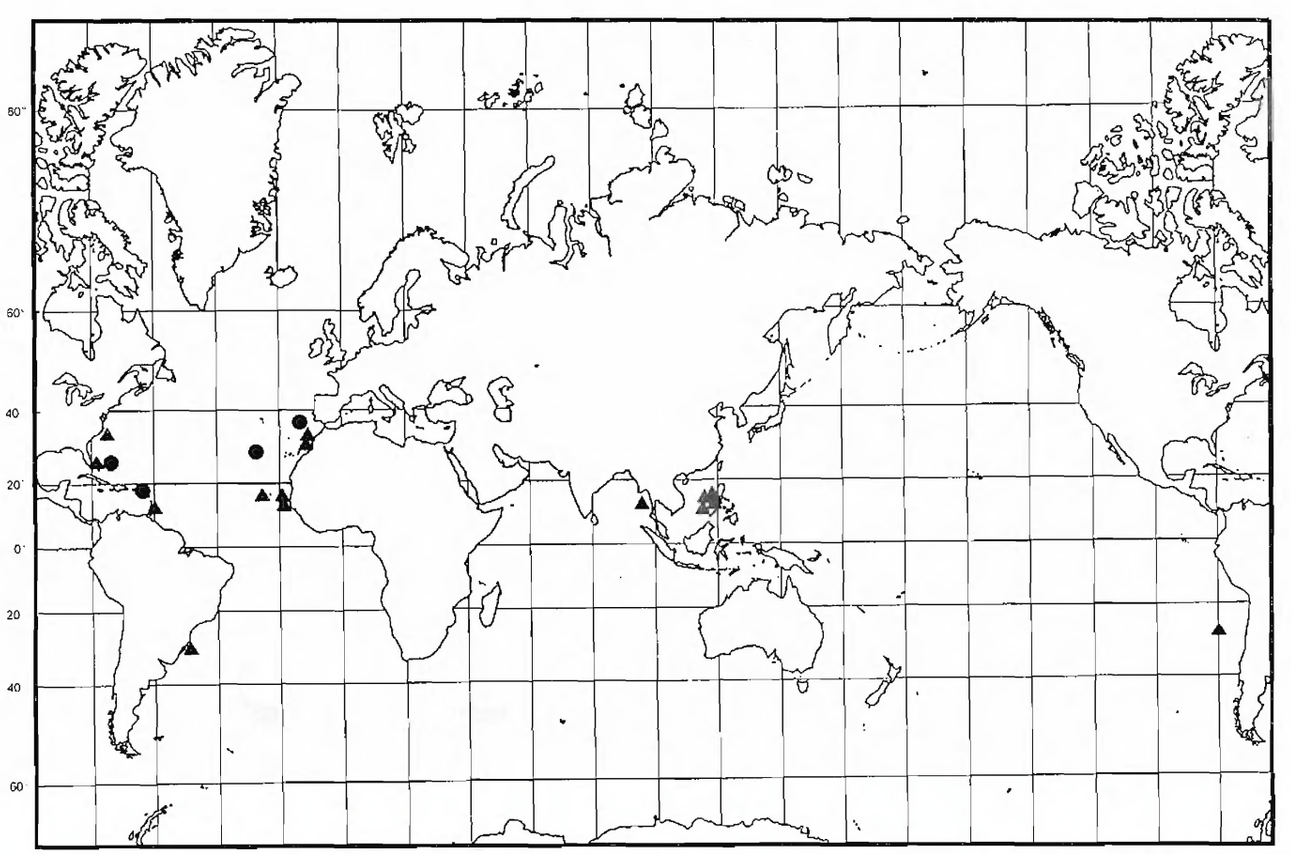

Fig.3- Geographic distribution: (●) *O. patens* Aurivillius, (▲) *H. cornuta* (Darwin).

Genus *Dichelaspis* Darwin, 1852
Dichelaspis thieli n.sp.
(Figs.5a-l, 6)

Material – Eastern Atlantic. HOLOTYPE: 1 Hermaphrodite, St. 8.19, AT9, 26.01.67, 33°34.2'N, 09°19.3'W, 1300m, SM. PARATYPE: 1 juvenile from the same locality, SM.

Diagnosis – Capitulum triangular, elongated, height 2.5 times its width. Scutum with length and width of occludent ramus twice length and width of basal ramus. Occludent ramus with a conspicuous apico-basal ridge at its upper 2/3. Tergum with occludent margin convex and base undulate,forming two concavities. Carina with apex reaching terga. Caudal appendage biarticulate.

Description – Capitulum (Figs.5a-c) triangular, elongated, height about 2.5 times width, laterally compressed. Occludent margin essentially straight, carinal convex. Cuticle thin and translucent, thebody within visible. Plates with slightly marked growth lines; plates of capitulum with a reduction during growth.

Scutum (Fig.5a) L-shaped, occludent ramus with its length and width twice that of the basal ramus. Occludent ramus with a conspicuous angular apico-basal ridge from apex to 2/3 of its length, forming a narrow occludent surface. Basal ramus decreasing in width towards distal end.

Tergum (Fig.5a) with occludent margin convex, carinal margin concave basal margin undulate, forming two concavities, the first receiving apex of scutum. A deep furrow in tergum surface occurs from first basal concavity to apex.

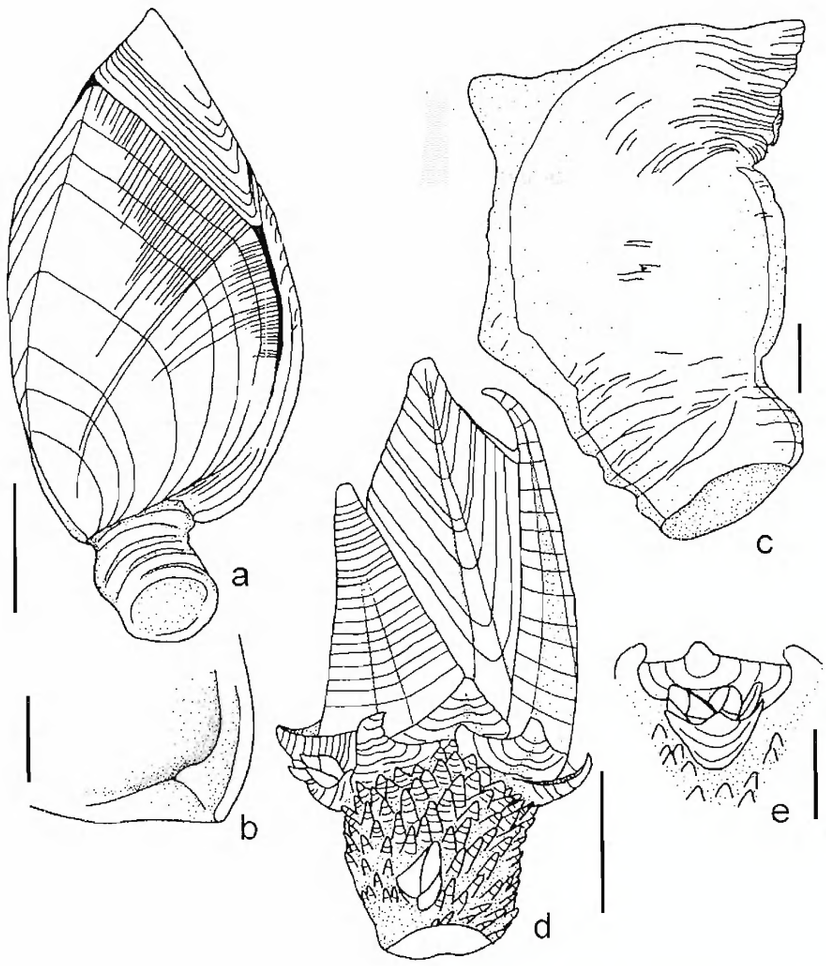

Fig.4- *Poecilasma aurantia* Darwin (St.19-136, KT106): a) lateral view, b) internal view of the umbonal angle of the right scutum. *Heteralepas cornuta* (Darwin): c) lateral view. *Aurivillialepas falcata* (Aurivillius) (St.19-131, AT97): d) lateral view, showing the males on the sub-rostrum and at the basis of peduncle, e) rostral view, showing the males. Bar: a, d) 2mm; b-c, e) 1mm.

Carina (Fig.5b) arcuate at lower part, apex reaching terga; tectum acute at umbo region and with a flat area increasing towards its apex, forming an inverted triangular surface. Basal region surrounds about one-half of peduncle, and terminates in blunt lateral projections.

Peduncle long, length more than one half of height of capitulum.

Juvenile specimen (Fig.5c) has fully calcified terga and scuta; tergum with only one concavity at basal margin; scutum with all occludent surfaces totally calcified, basal arm broadest at its extremity.

Labrum (Fig.5d) with one row of small teeth. Palp (Fig.5d) short, covered by long simple setae. Mandible (Figs.5e-f) with three acute teeth and two blunt teeth angled downwards, last confluent with

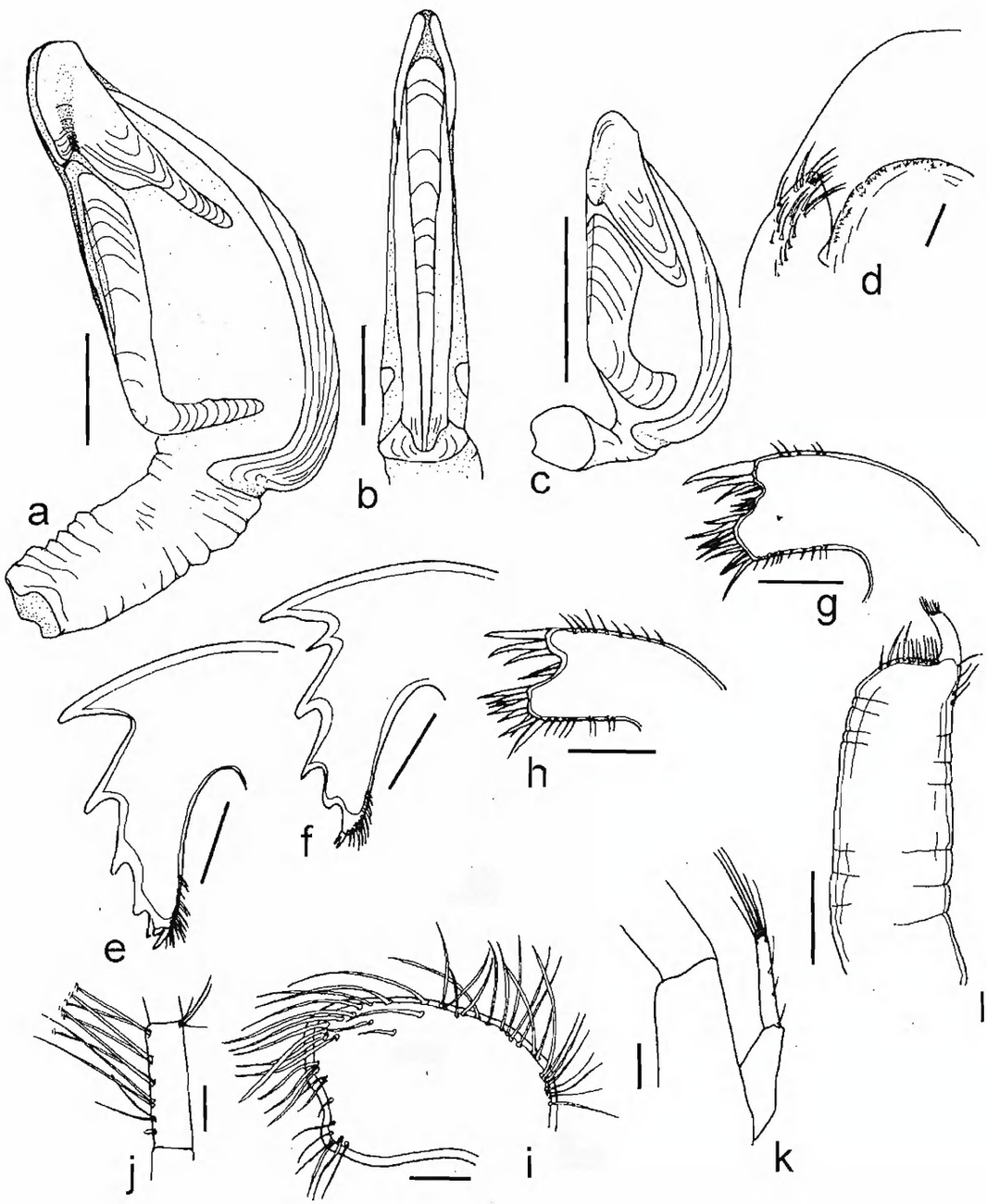

Fig.5- *Dichelaspis thieli* n.sp., Holotype: a) lateral view of the full grown specimen, b) carinal view; Paratype: c) right view of the young specimen; Holotype: d) labrum and palp, e-f) mandibles, g-h) maxilla I, i) maxilla II, j) median article of cirrus III, k) caudal appendage, l) distal portion of penis. Bar: a-c) 2mm; d-h, j-l) 0.2mm; i) 0.5mm.

lower angle; a small tooth may be present between first two teeth. Maxilla I (Figs.5g-h) with two steps, lower one projecting; upper angle with one large and two median spines, followed by a shallow notch and numerous medium and small spines directed downward along cutting border. Maxilla II (Fig.5i) triangular, with numerous simple setae.

Cirrus I with shorter ramus 3/4 length of longer, armed with numerous stout setae along its margins. Cirri II to VI with subequal rami, median articles well developed on cirri III and IV, their length about 1/3 of their width, with 6 pairs of simple setae on anterior margin and a tuft of setae at postero-distal angle (Fig.5j). Number of articles cirri I-VI and caudal appendage is presented in table 1. Caudal appendage (Fig.5k) biarticulate, longer than first basal article of cirrus VI; with scattered setae at posterior margin and a terminal tuft.

Penis short, with a conspicuous latero-distal languet, with thin setae along its distal end (Fig.5 l).

The holotype has a capitular length of 9.5mm of and a peduncular length of 4.5mm and the paratype is 4mm and 1mm, respectively.

TABLE 1

NUMBER OF ARTICLES OF CIRRI I-VI, AND CAUDAL APPENDAGES OF THE HOLOTYPE OF *DICHELASPIS THIELI* N.SP.

	CI	CII	CIII	CIV	CV	CVI	CA
RC	7/9	16/13	14/13	15/7*	15/13*	15/13*	2
LC	7/9	15/14	15/16	17/15	17/17	16/15	2

(*) cirri with abnormal growth form, many of which are small and undeveloped. (CI-VI) cirri I to VI; (CA) caudal appendage; (RC) right cirri; (LC) left cirri.

Etymology – Named in honor of Dr. H. Thiel, who was largely responsible for collecting the samples and made them available the study.

Remarks – The genus *Dichelaspis* Darwin, 1852, is usually considered to be synonymous with *Octolasmis* Gray, 1825. Nonetheless, the species of *Octolasmis s.l.* can be divided into two groups. The first group - *Octolasmis s.s.* - comprises the small species associated with decapod crustaceans. It is characterized by having a capitulum that is oval in outline, has few calcified plates, and the carina is regularly arched and usually forked.

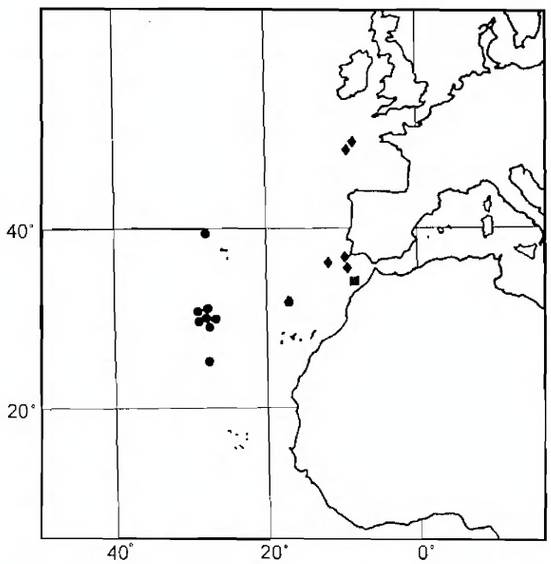

Fig.6- Geographic distribution: (■) *Dichelaspis thieli* n.sp., (●) *Heteralepas microstoma* (Gruvel), (◆) *Verum parazelandiae* n.sp.

The second group – *Dichelaspis* – embraces deep sea and free living species not found on the gills of crustaceans. The capitular shape of these species is elongated and triangular in outline, they have more strongly calcified plates, the carina is angular, and has a disk at its base. These species were included in the subgenus *Dichelaspis* by PILSBRY (1907a) who cited *Octolasmis orthogonia* Darwin as the type species. He included in this group *D. sessilis* (Hoek, 1883); *D. americanum* (Pilsbry, 1907) and later also *D. hawaiense* Pilsbry, 1907 (PILSBRY, 1907b). The generic status was accepted by PILSBRY (1907b) and NEWMAN, ZULLO & WITHERS (1969).

Dichelaspis thieli n.sp. is distinguished from *D. orthogonia* and *D. americanum* by the shape of the terga and scuta. On the other hand, it is similar to *D. hawaiense* from which it can be separated by a more longthened capitulum, which is about 2.5 times its width, a straighter occludent margin, and a carinal apex reaching the terga.

The description of *D. sessilis* was based on a young specimen from the Azores, taken at 1828m (HOEK, 1883), which is not far from the locality of this new species. The plates of *D. sessilis* are not reduced and many of its characters are related to its young generalized stage. It is difficult to determine the shape of the plates unless full grown. *Dichelaspis sessilis* was later recorded by WELTNER (1922) and NILSSON-CANTELL (1927) from the Indian ocean, based also on generalized young specimens. These may be the young of another species.

Dichelaspis thieli n.sp. is only distantly related to *D. sessilis* because of the following differences: the capitulum length of *D. sessilis* is less than twice its width; the carinal apex does not reach the terga, and the reduction in plate calcification of this species is less than the smaller specimen of *Dichelaspis thieli* n.sp. Also, *D. thieli* n.sp. has a biarticulated caudal appendage, a character not observed before in any other species of Poecilasmatidae. All of the other species has a single, uniarticulated caudal appendage (see ZEVINA, 1982).

Family Lepadidae Darwin, 1852
Genus *Lepas* Linnaeus, 1758
Lepas anatifera Linnaeus, 1758

Lepas anatifera Linnaeus, 1758: 668.

Lepas anatifera: DARWIN, 1852:73, pl.1, fig.1, 1a-c.

Material – Eastern Atlantic. 30°N, 29°W, 5+ spec, SM.

Remarks – This is a common cosmopolitan species found attached on floating objects. The present specimens ranged from small to 25mm total length (capitulum length 15mm).

Genus *Conchoderma* Olfers, 1814
Conchoderma auritum (Linnaeus, 1767)

Lepas aurita Linnaeus, 1767:1110.

Conchoderma auritum: DARWIN, 1852:141, pl.3, figs.4, 4a-c.

Material – Eastern Atlantic. St. 36, Meteor seamounts, without detailed locality, 67 spec, SM.

Remarks – This is another common cosmopolitan species found on whales and ships. The specimens ranged from small to 41mm total length (capitulum length 18mm).

Suborder Heteralepadomorpha Newman, 1987
Family Heteralepadidae Nilsson-Cantell, 1921
Genus *Heteralepas* Pilsbry, 1907
Heteralepas microstoma (Gruvel, 1901)
(Figs.6, 7a-j)

Alepas microstoma Gruvel, 1901:259.

Alepas microstoma: GRUVEL, 1902b:282, pl.24, figs.1B, B', 7, 8; 1905:162, fig.180.

Material – Eastern Atlantic. 39°57.7'N, 28°25.1'W, 305-316m, 1 spec, SM; 30°09.5'N, 28°32.2'W, 333m, 64 spec, SM; 30°08'N, 28°38.5'W, 269m 9 spec, SM; 30°07'N, 28°27'W, 313-323m, 17 spec, SM; 30°06.7'N, 28°25.7'W, 323-314m, 108 spec, SM; 30°06.0'N, 28°28.4'W, 303m, 97 spec, SM; 30°04'N, 28°24.5'W, 328m, 13 spec, SM; 30°04.5'N, 28°38'W, 298-318m, 32 spec, SM; 30°03.0'N, 28°40.0'W, 450-505m, 1 spec, SM; 30°03'N, 28°23'W, 303-333m, 82 spec, SM; 30°01'N, 28°24.0'W, 315-320m, 33 spec, SM; 30°01.3'N, 28°37.2'W, 328-312m, 122 spec, SM; 29°59.5'N, 28°23.0'W, 303-333m, 120 spec, SM; 29°59'N, 28°33'W, 290m, 2 spec, SM; 29°58'N, 28°20'W, 318-418m, 212 spec, SM; 29°55.9'N, 28°35.0'W, 308-330m, 209 spec, SM; 29°55.5'N, 28°30'W, 288-293m, 163+ spec, SM; 29°55'N, 28°20'W, 300m, 2 spec, SM; 29°53'N, 28°23.5'W, 303-318m, 191 spec, SM; 29°50.2'N, 28°23.8'W, 300-304m, 76 spec, SM; 29°50.2'N, 28°29.8'W, 308-310m, 53 spec, SM; 29°46'N, 28°29'W, 623-316m, 13 spec, SM; 25°56.5'N, 28°36.1'W, 323-238m, 117 spec , SM. Mar de Fortuna, Azores, 548m, 7 spec, SIO-C9732.

Description – Cuticle (Figs.7a, b) thick, with numerous transverse grooves, occasionally also with small warts, not pilose. Aperture (Fig.7c) small, less than one-half of capitulum length, folded. Scutal area distinct, with small warts, and a small longitudinal crest below aperture (Fig.7c). Carinal crest (Fig.7b) low but conspicuous, occurring along whole capitulum margin and reaching to base of peduncle; somewhat more acuminate on capitulum. Peduncle cylindrical, usually same length as capitulum, but not uncommonly reaching three times length of capitulum.

Labrum (Fig.7d) bullate, crest with one row of large teeth. Palp (Figs.7d-e) long, acuminate, covered with long pinnate setae. Mandible (Fig.7f) with four teeth, first three acute, forth rhombic; lower angle molariform. Maxilla I (Fig.7g) with a deep notch, upper angle with one large and one moderately long spine, lower border with numerous small and median spines. Maxilla II (Fig.7h) rectangular with numerous moderate to large pinnate setae on cutting margins.

Cirrus I with shorter ramus about 3/4 length of longer, both rami with articles protuberant; one filamentary appendage at its base. Cirri II to IV with subequal rami (Fig.7i). Cirri V and VI with reduced inner rami, medial articles (Fig.7j) short, height 2/5 of width, with one pair of long pinnate setae and one pair of setules on anterior margin.

Caudal appendage (Fig.7i) multiarticulated (10), as long as basal articles of cirrus VI, with setae at distal margins.

Penis short, with small setules along its length.

The specimens ranged from small to 64mm overage length (capitulum length to 23mm).

Remarks – GRUVEL (1902b) described this species based on specimens from Madeira. His photograph and drawings shows a distinct pigmented area at the upper region of the capitulum but he did not mention this in his description. These distinct areas were observed in some specimens and is due to the translucent upper surface near the carinal crest. Additionally, he described a low carinal crest along the capitulum, without mentioning if it is still present or not on the peduncle. The specimens I examined have this carinal crest in lateral view, but which is more conspicuous in carinal view. This crest occurs along the capitulum and peduncle.

Most samples found at depths of 300m represent this species, and commonly in great numbers (Fig.6). They were commonly found attached to gorgonian stems and occurred in large clusters. The smaller specimens are usually found attached at the base of larger ones. In large clusters the specimens usually the other hand, had a peduncle the same length as the capitulum. had an elongated peduncle, common exceeding 3 times the length of capitulum. Isolated specimens, on the other hand, had a peduncle the same length as the capitulum.

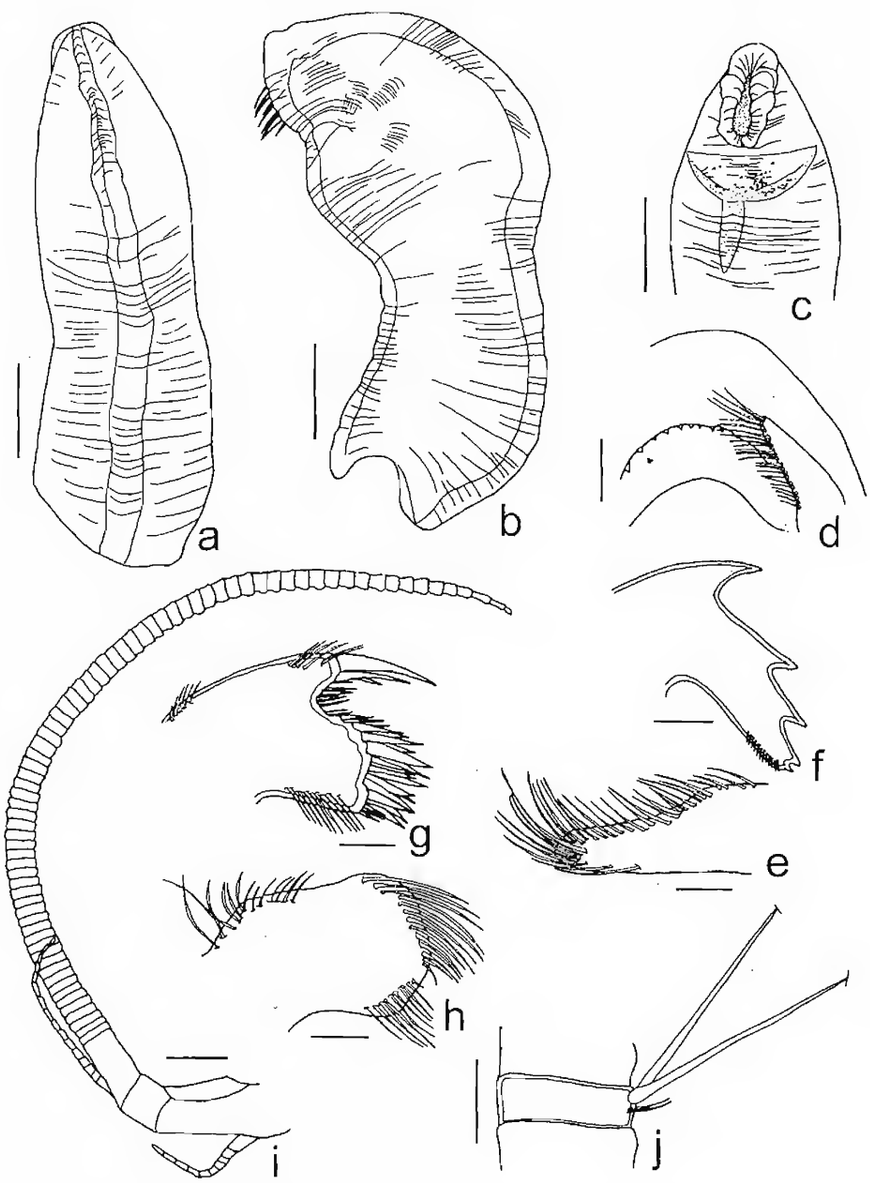

Fig.7- *Heteralepas microstoma* (Gruvel) (St. 19-163, KT123): a) carenal view, b) lateral view, c) rostral view, d) labrum and palp, e) palp, f) mandible, g) maxilla I, h) maxilla II, i) cirrus VI and caudal appendage, j) median article of cirrus VI. Bar: a-c) 4mm; d-h, j) 0.3mm.

Heteralepas cornuta (Darwin, 1852)
(Figs.3, 4c)

Alepas microstoma Darwin, 1852:165, pl.III, fig.6, pl.X, fig.8, 22.

Alepas microstoma: GRUVEL, 1905:161, fig.178.

Heteralepas cornuta: PILSBRY, 1907a:101; BROCH, 1927:16, pl.IV, figs.26-29; NILSSON-CANTELL, 1938a:27; ROSS, CERAME-VIVAS & MCCLOSKEY, 1964:312; STUBBINGS, 1964a:107; 1965:880; ROSS, 1975:17, fig.1; ROSELL, 1981:287, pl.IV, fig.g-l; 1991:31, fig.5d; ZEVINA, 1982:116, fig.102; YOUNG, 1995:239.

Material – Eastern Atlantic. 31°35.0'N, 10°10.5'W, 150-160m, 5 spec, SM.

Remarks – *Heteralepas cornuta* (Fig.4c) has a world-wide distribution and was previously recorded from the coast of Africa by BROCH (1927) and STUBBINGS (1964a; 1965) (Fig.3). The present specimens varied from 6mm to 9mm in total length (capitulum length 1 to 6mm).

Suborder Scalpellomorpha Newman, 1987

Remarks – The internal view of the median-latus from *Neolepas rapanuii* Jones, 1993, *Gruvelialepas pilsbryi* (Gruvel, 1911), *Pollicipes pollicipes* (Gmelin, 1790), and *Capitulum mitella* (Linnaeus, 1767) are illustrated in figure 8. The outer view of the median-latus plate is outlined in broken lines. The median-latus of *N. rapanuii* and *P. pollicipes* are almost totally incorporated into the capitulum, *i.e.* they are covered by the chitinous portion of the capitulum. In *G. pilsbryi* this plate projects outward whereas in *C. mitella* it is incorporated in the capitulum, but it also projects upward, covering the scutum and tergum. The median-latus in these forms probably represent the first experiments which subsequently become the upper-latus in the Scalpellidae *s.s.* After the incorporation of this plate in the capitulum, the Scalpellidae transferred it to the upper whorl.

Family Calanticidae Zevina, 1987
Genus *Gruvelialepas* Newman, 1980
Gruvelialepas pilsbryi (Gruvel, 1911)
(Figs.8b, 9)

Scalpellum pilsbryi Gruvel, 1911:290.

Scillaelepas (Gruvelialepas) pilsbryi: NEWMAN, 1980:391.

Material – Eastern Atlantic. St. M36-98, AT 149; Meteor seamounts, without detailed locality, 1 spec, SM.

Remarks – NEWMAN (1980) recently reviewed this species. The sole specimen examined herein has a total length of 27mm (capitulum length 14mm) (Fig.9).

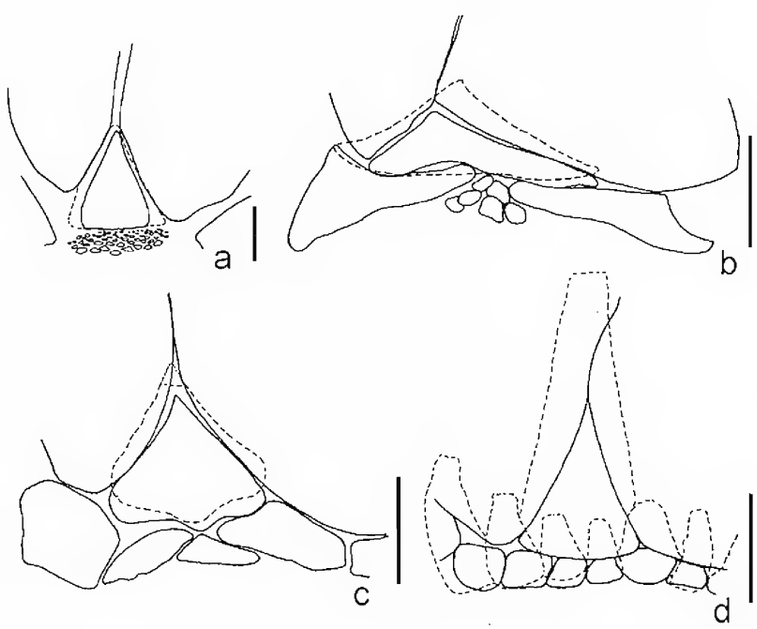

Fig.8- Internal view of median-latus area, with theoutline of the external view of the median-latus: a) *Neolepas rapanuii* Jones, 1993, b) *Gruvelialepas pilsbryi* (Gruvel), c) *Pollicipes pollicipes* (Gmelin), d) *Capitulum mitella* (Linnaeus, 1767), but also with the outline of all basal whorl of plates. Bar: 3mm.

Genus *Aurivillialepas* Newman, 1980
Aurivillialepas falcata (Aurivillius, 1898)
(Figs.4d-e, 9)

Scalpellum falcatum Aurivillius, 1898:193.

Scillaelepas (Aurivillialepas) falcata: NEWMAN, 1980:381.

Material – Eastern Atlantic. 36°36.7'N, 14°14.0'W, 300-170m, 3 spec each one with one male, SM; 30°08'N, 28°38.5'W, 269m, 1 spec, with four males, SM; 29°47.9'N, 28°23.3'W, 300-310m, 1 spec, with one male, SM.

Remarks – This species (Fig.4d) was first described from the Azores from 454m (AURIVILLIUS, 1898, GRUVEL, 1920). The previously described specimens are larger (capitulum length: 10mm) than those I examined (capitulum length: from 3 to 6mm; 4 to 11mm total length), all of which were collected near the type locality. Most of the specimens had one small male between the rostrum and subrostrum, but one specimen had three males in this position and another one at the base of the peduncle (Figs.4d-e) which, in this position, would not be able to copulate with the female. The smaller specimen did not have any males present. There are differences in the latitude cited by AURIVILLIUS (1898) and GRUVEL (1920) for the same sample studied by both of them- I have used the former record in the distribution locations (Fig.9).

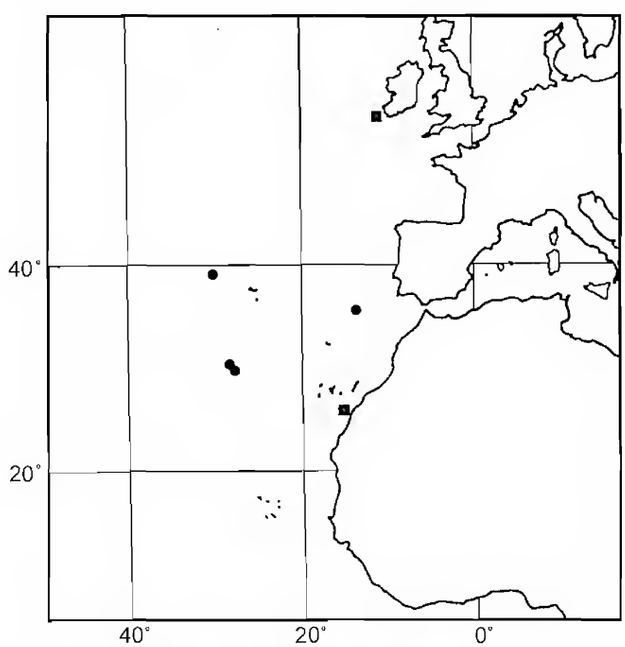

Fig.9- Geographic distribution: (■) *Gruvelialepas pilsbryi* (Gruvel), (●) *Aurivillialepas falcata* (Aurivillius).

Family Pollicipedidae Leach, 1817
Genus *Pollicipes* Leach, 1817
Pollicipes pollicipes (Gmelin, 1790)
(Fig.8c)

Lepas pollicipes Gmelin, 1790: 3213.

Material – Eastern Atlantic. 38°21.9'N, 08°56.4'W, 85-90m, 2 spec, SM.

Remarks – This species is common in the intertidal zone along the coasts of Spain and Portugal, to north Africa. The record of this species herein from 85-90m is unusual; this specimen may have been taken from a shallower depth during the dredge haul. One specimens had 23mm total length, the other was broken (capitulum length 14 and 15mm).

Family Scalpellidae Pilsbry, 1907
Subfamily Scalpellinae Pilsbry, 1907
Genus *Scalpellum* Leach, 1817
Scalpellum scalpellum (Linnaeus, 1767)

Lepas scalpellum Linnaeus, 1767:1109.

Scalpellum scalpellum: DARWIN, 1852:222, pl.5, fig.15.

Material – Eastern Atlantic. 37°22.8'N, 09°00.7'W, 170-150m, 5 spec, SM; 31°35.0'N, 10°10.5'W, 150-160m, 2 spec, SM.

Remarks – This is a common species found in shallow waters along European and North African coasts (NILSSON-CANTELL, 1978). The specimens varied from 18mm to 31mm in total length (capitulum length 12mm to 18mm).

Subfamily Meroscalpellinae Zevina, 1978
Genus *Neoscalpellum* Newman & Ross, 1971
Neoscalpellum debile (Aurivillius, 1898)
(Fig.10a-j, 11)

Scalpellum debile Aurivillius, 1898:189.

Scalpellum debile: GRUVEL, 1905:27; 1920:31, pl.V, figs.13-15, pl.VII, fig.1.

Scalpellum edwardsii Gruvel, 1900a:189.

Scalpellum edwardsii: GRUVEL, 1902a:63, pl.II, figs.3B, 16; 1905:28, fig.27.

Scalpellum dicheloplax Pilsbry, 1907a:70, fig.28a-c.

Scalpellum dicheloplax: HOEK, 1914:4.

Scalpellum dicheloplax benthophila Pilsbry, 1907a:73, fig.28d.

Scalpellum alboranense Gruvel, 1920:33, pl.V, figs.4-6.

?*Scalpellum (Arcoscalpellum) dicheloplax benthophila*: WELTNER, 1922:67.

Neoscalpellum debile: NEWMAN & ROSS, 1971:96, figs.49-50.

Meroscalpellum bifurcatum: FOSTER & BUCKERIDGE, 1995a:173, fig.7A-B.

Material – Eastern Atlantic. 42°55.4'N, 14°07.9'W, 5260m, 2 spec, SM; 42°44.5'N, 13°29.8'W to 42°36.5'N, 13°34.3'W, 5315m, 7 spec, SM; 42°38.5'N, 13°31.0'W, 5318m, 2 spec, SM; 42°17.2'N, 14°46.3'W, 5270m, 16 spec, SM; 42°04.1'N, 14°55.6'W, 5275m, 18 spec, SM.

Description – Capitulum (Figs.10a-h) length twice its width, flattened, with reduced plates in large specimens, and with a thick cuticle interconnecting them; occludent and carinal margins similarly convex.

Tergum (Figs.10a-h) with notch in basal margin, which appears in specimens when about 10mm in capitulum length, becoming deeper in older ones, notch dividing plate into two arms. Carinal and occludent arms same width, and former about 1.5 times length of occludent.

Scutum (Figs.10a-h) length about twice its width, with an apical arm, which becomes thinner with development, length less than 1/4 of scutum length; basal margin usually with a small notch medially; an apical conspicuous furrow runs from concavity between lateral arm and lateral margin to apex. Apex recurved and superposed on tergum.

Carina (Figs.10a-i) arched and larger at upper half. Umbo slightly subapical, forming a rounded upper surface. Tectum flat, with a shallow groove on each side of borders, border angularly bent; basal margin rounded.

Upper-latus (Figs.10a-h) irregular in shape; apex produced outward, forming lateral projection extending through cuticle; projection usually more developed in scutal margin and forming a small apical arm in larger specimens; basal margin has an increasingly deep notch which divides plate in two nearly equal arms; some larger specimens have smaller notches on basal margins of both arms.

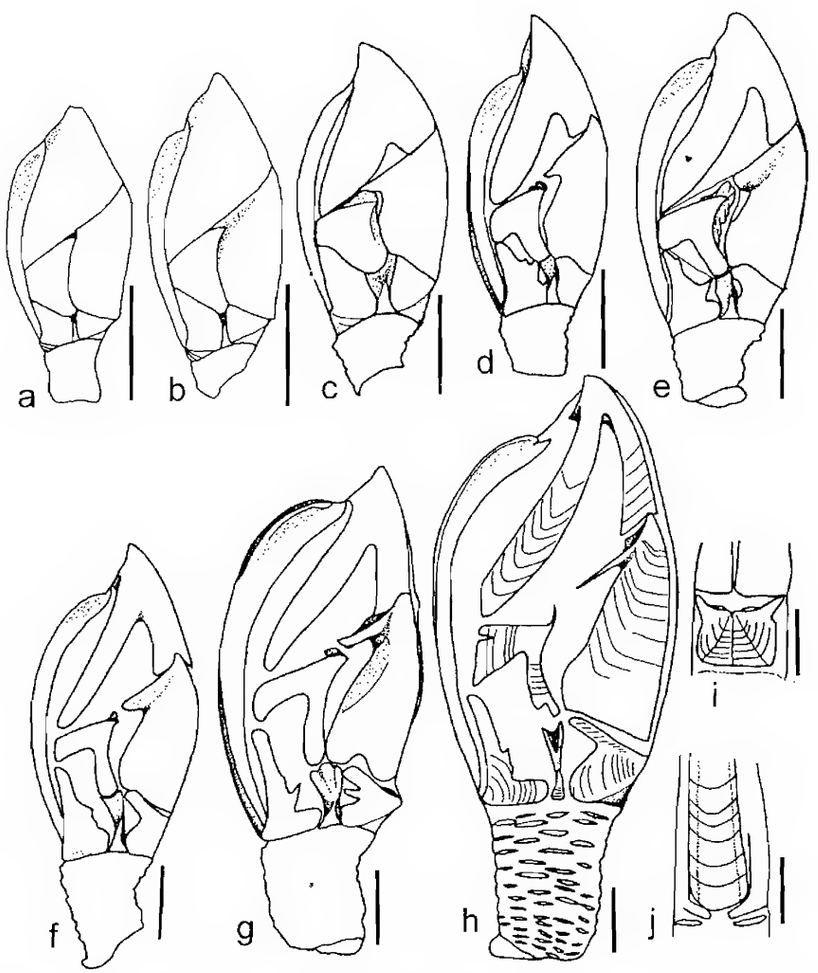

Fig.10- *Neoscalpellum debile* (Aurivillius): a-h) lateral view of numerous distinct developmental stages, i-j) rostral and carinal view of the larger specimen. All specimens from St. 3-24, except c, from St. 3-37. Bar: a-b) 4mm; c-j) 5mm.

Carino-latus generally triangular in shape, with umbo near base of carina; carinal margin concave, basal margin nearly straight and lateral margin irregularly excavated. Carino-latera separated from each other under carina.

Inframedian latus with central umbo, displaced outward; forming a basal triangle with two divergent upwards arms, having a general hour-glass appearance.

Rostro-latus essentially square, with an apico-basal ridge; lateral margin excavated in larger specimens, usually forming a slender upper arm.

Rostrum (Fig.10j) a narrow vertical strip between rostro-latera in smaller specimens, visible as a small apical triangle in median-size specimens, and not visible in large ones.

Peduncle less than one-half length of capitulum, with slender scales mostly covered by cuticle.

The specimens varied from 14 to 43mm of total length (capitulum length 11 to 32mm).

Discussion – AURIVILLIUS (1898) described briefly *Scalpellum debile* based on material from the Azores, from depths between 4400 and 5005m. GRUVEL (1920) provided a detailed description and also figured this species. Unfortunately some of his figures are poorly printed photographs (pl.V, fig.15), nevertheless his figure 1 from pl.VII, details the capitular characters. Between 1898 and 1920, four new species and subspecies of this group were described from the northern Atlantic (AURIVILLIUS, 1894; GRUVEL, 1920). GRUVEL (1900a, in detail in 1902a) described *S. edwardsii* from the same area as *S. debile* at a depth of 4255m. PILSBRY (1907a) described *Scalpellum dicheloplax* from the Northeastern Atlantic, from depths between 2788 and 2822m, and the subspecies *benthophila* from the same area, at 2844m. GRUVEL (1920), in the same study in which he redescribed *S. debile*, also described *S. alboranense* from the same area as the former, from 4400-5005m, but failed to discuss their differences or affinities.

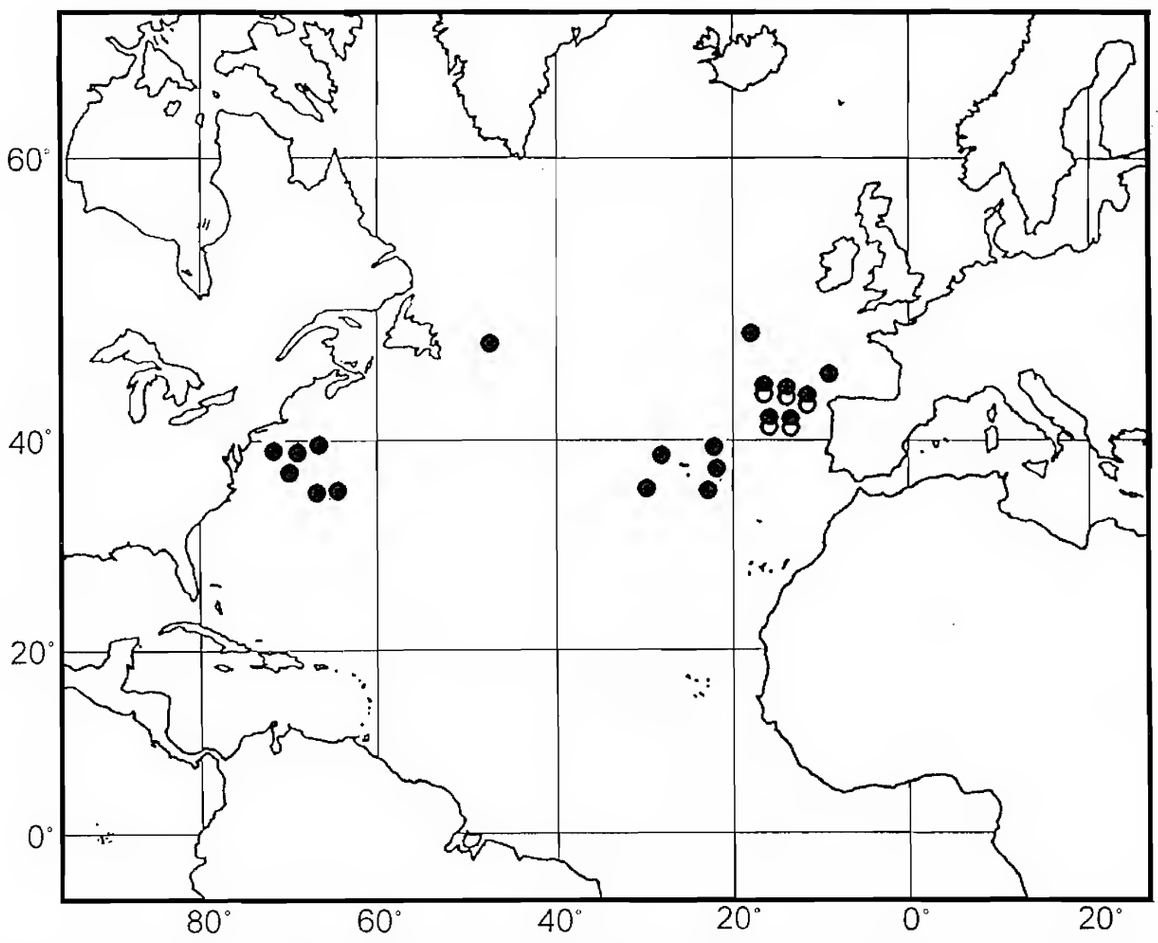

Fig.11- Geographic distribution: (●) *Neoscalpellum debile* (Aurivillius), (○) *Litoscalpellum meteoria* n.sp.

Several authors (NILSSON-CANTELL, 1955; NEWMAN & ROSS, 1971; ZEVINA, 1976; 1981a) considered these species as synonyms, being the only species of *Neoscalpellum* occurring in the northern Atlantic. The descriptions of these species were based on specimens within distinct size classes: *S. debile* - capitulum length (cl): 32mm; *S. edwardsii* - cl: 25mm; *S. dicheloplax* cl: between 44mm (type) and 28mm (measure taken from fig.28c); *S. dicheloplax benthophila* - 15mm and, *S. alboranense* - cl: 25mm. All these apparently represent species distinct stages in the development of the same species as noted by NEWMAN & ROSS (1971).

S. debile is about the same size as the specimen depicted here in figure10h. The carino-latus has a deeper notch with thinner arms and the inframedian latus has a Y shape, due to the formation of a notch at the upper angle. This stage appears to be a little more reduced than that figured herein.

S. edwardsii is about the same size as the specimen in figure 10g, and appears to be in the same development stage as that shown in figure 10f.

S. dicheloplax was based on a full grown specimen, which I have not seen. Its stage of development represents greatly reduced plates, with a relatively deeper notch in the carino-lateral, as well as in the scutal and tergal margins, and a decidedly Y-shaped inframedian latus.

S. dicheloplax benthophila likely represents a juvenile stage equivalent to that represented in figure 10d.

S. alboranense is apparently the same size as that presented in figure 10g. GRUVEL (1920) described it as having an entire rostro-latus, but his photograph in figure 4 of plate V, shows a notch in its lateral margin.

All the descriptions from GRUVEL (1902a; 1920) for *S. edwardsii, S. alboranense* and, *S. debile* cite the carina as being flat or slightly concave bordered by thin bordering ribs. Actually, the carina, when the cuticle is removed, appears to have a slightly lateral groove in each side, forming a lateral area which may be described as a "lateral rib".

The record of this species as *Scalpellum (Arcoscalpellum) dicheloplax benthophila* from the Indian ocean (WELTNER, 1922) is probably a misidentification. Excluding this reference, this species has a distribution restricted to the Northern Atlantic (Fig.11).

The presence of an excavation on the basal margin of the scutum distinguishes *Neoscalpellum* from *Meroscalpellum* (ZEVINA, 1981a). *N. debile* occasionally has this excavation, but usually the basal margin is straight. This variation probably confused FOSTER & BUCKERIDGE (1995a), who recorded *Meroscalpellum bifurcatum* (Zevina, 1973) from off Tristan da Cunha and off Angola. Their specimens likely represent *N. debile*, and if so, this extends its distribution to the South Atlantic.

Genus *Litoscalpellum* Newman & Ross, 1971
Litoscalpellum meteoria n.sp.
(Figs.11, 12a-o)

Material – Eastern Atlantic. HOLOTYPE: 1 Female, st 3-29, 12.03.66, 42°17.2'N, 14°46.3'W, 5270m, SM. PARATYPES: same locality, 8 spec; 42°55.4'N, 14°07.9'W, 5260m, 5 spec, SM; 42°44.5'N, 13°29.8'W to 42°36.5'N, 13°34.3'W, 5315m, 7 spec, SM, USNM 274312; 42°38.5'N, 13°31.0'W, 5318m, 6 spec, SM; 42°04.1'N, 14°55.6'W, 5275m, 9 spec, SM, USNM 274309.

Diagnosis – Scutum with length of lateral arm less than 1/3 length of tergal margin. Tergum having a basal margin with a shallow concavity in larger, and straight in smaller specimens. Upper-latus with a concavity on its basal margin. Inframedian latus hour-glass shaped. Caudal appendage with 8 articles, length nearly twice length of basal articles.

Description – Capitulum (Figs.12a-e) oval, flattened, length less than twice width; covered by a thick cuticle. Plates reduced in large specimens, and with conspicuous, spaced, growth lines.

Tergum (Figs.12a-e) triangular with its surface area larger than scutum. Basal margin with a shallow concavity in larger and straight in smaller specimens. Carinal margin slightly convex with a lateral thickening near apex of carina. Occludent margin convex. Apex recurved.

Scutum (Figs.12a-e) convex, with a short lateral arm, length less than 1/3 length of tergal margin, with a conspicuous groove running from notch under lateral arm to apex; another shallower depression extends from basal margin to apex. Basal margin straight or slightly concave. Tergal margin slightly concave and thickened. Occludent margin slightly convex. Apex superimposed on tergum.

Carina (Figs.12a-f) regularly arched, usually thicker at upper half, umbo slightly subapical. Tectum flat with a shallow groove on each side of borders; lateral angulary bent; basal margin rounded.

Upper-latus (Figs.12a-e) pentagonal with apex usually slightly projecting above surface of capitulum. Carino-lateral margin from straight in smaller specimens to deeply concave in larger ones, forming two arms; both arms similar in width. Scutal margin concave and tergal convex.

Carino-latus (Figs.12a-f) high, 1.5 to 2 times its width, with umbo below base of carina, slightly projecting outward. Lateral margin convex in small specimens and developing shallow concavities in larger ones, having an irregular outline. Carino-latera in contact with one another, but not interdigitating.

Inframedian latus (Figs.12a-e) hour-glass shaped with umbo supramedial, usually little reduced; umbo projecting outwards.

Rostro-latus (Fig.12a-e, g) as high as wide in small specimens, and higher in larger ones, with an apico-basal ridge. Lateral margin slightly concave in larger specimens.

Rostrum (Fig.12h) in smaller specimens is a thin vertical strip between rostro-latera, and in larger specimens, visible only as a small apical rounded projection.

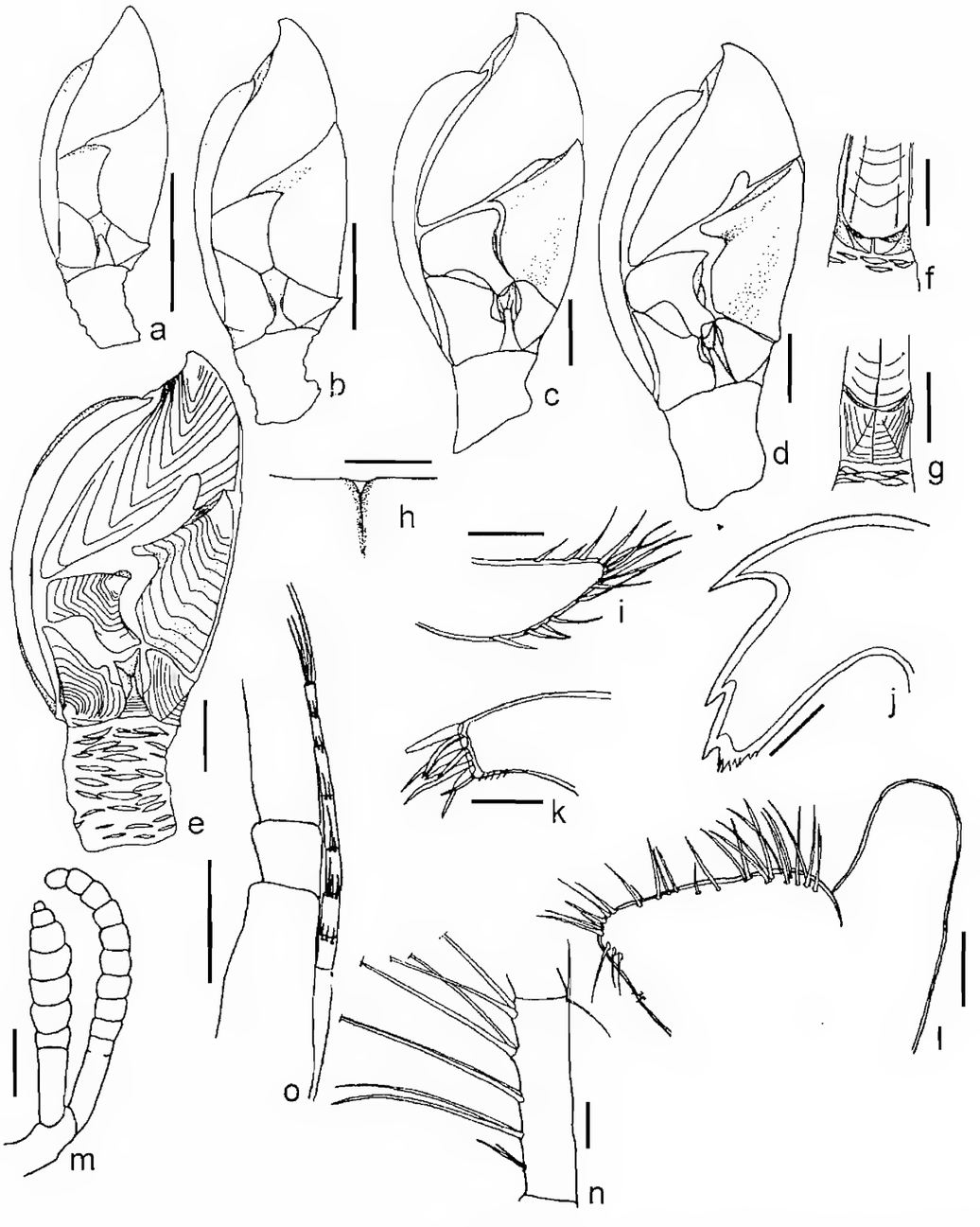

Fig.12- *Litoscalpellum meteoria* n.sp. (St. 3-24), Paratypes: a-d) lateral view of several distinct developmental stages; Holotype: e) lateral view, f) carinal view, g) rostral view, h) detail of the rostrum; Paratype: i) palp, j) mandible, k) maxilla I, l) maxilla II, m) outline of cirrus I, n) median article of cirrus VI, o) protopodite of cirrus VI and caudal appendage. Bar: a-g) 4mm; h) 1mm; i-l, n) 0.2mm; m, o) 0.1mm.

Peduncle (Figs.12a-e) short, less than one-half length of capitulum, covered sparsely by scales deeply immersed in cuticle.

Labrum bullate, without teeth. Palp (Fig.12i) acuminate with long, thin setae on its margins. Mandible (Fig.12j) with three acute teeth, inferior one near lower angle; lower angle denticulate. Maxilla I (Fig.12k) small, with straight anterior border, and 7-8 large and median size and unpaired spines. Maxilla II (Fig.12 l) nearly triangular, covered by numerous large and simple setae; maxillary gland pronounced. Cirrus I (Fig.12m) with shorter ramus 4/5 length of longer ramus; former with protuberant articles; both rami covered by numerous large, simple or slightly pinnate setae. Cirrus II with subequal rami and cirri III to VI with equal rami. Median article of cirrus VI (Fig.12n) 4 times longer than wide, 5 pairs of setae on anterior margin and 1-3 setae on posterior angle.

Caudal appendage (Fig.12o) with 8 articles, nearly twice length of basal articles of cirrus VI; articles with setae on their distal margins.

The holotype has a capitulum length of 31mm, 36mm total length. The paratypes ranged from 10 to 31mm in total length (capitulum length 8 to 23mm).

Etymology – Named in honor of the German "Fisheries Steamer Meteor", which collected the specimens.

Remarks – The shape of certain capitular plates in *Litoscalpellum meteoria* n.sp. changes dramatically with development, but these changes are not as evident as in the related *Neoscalpellum debile*. Some stages of development of *Litoscalpellum* may be inferred to be young stages of *N. debile*. The large series I studied made it possible to sketch the development of both species. The reduction of the plates in *N. debile* appears in small specimens and the tergum early becomes notched. Otherwise, the shallow notch of *L. meteoria* n.sp. only appears in nearly full grown specimens. *Litoscalpellum meteoria* n.sp. does not reach the same capitular length as *N. debile*, from which it is distinguished by a deep excavation in the tergum and upper-latus, forming two arms in each plate, instead of shallow notches as in the plates of *L. meteoria* n.sp. Otherwise, *L. meteoria* n.sp. exhibits a shallow apico-basal groove on the scutum and a more lengthened caudal appendage and median articles.

Excluding *L. meteoria* n.sp., within *Litoscalpellum*, only *L. korotkevitschae* (Zevina, 1968), *L. glandulosum* (Zevina, 1972), *L. simplex* Newman & Ross, 1971 and, *L. intermedium* (Hoek, 1883) possess a lateral arm on the scutum, but only the latter has an upper-latus with a concavity on its basal margin (ZEVINA, 1981a).

L. intermedium, from Australia, may be distinguished by a truncated lateral arm on the scutum, a lesser arched carina, a larger upper-latus with a shallow concavity at its basal margin, a rostro-latus that is wider than higher, and a triangular inframedian latus (HOEK, 1883).

L. meteoria is known only from the Azores. It invariably occurs with *N. debile* (Fig.11).

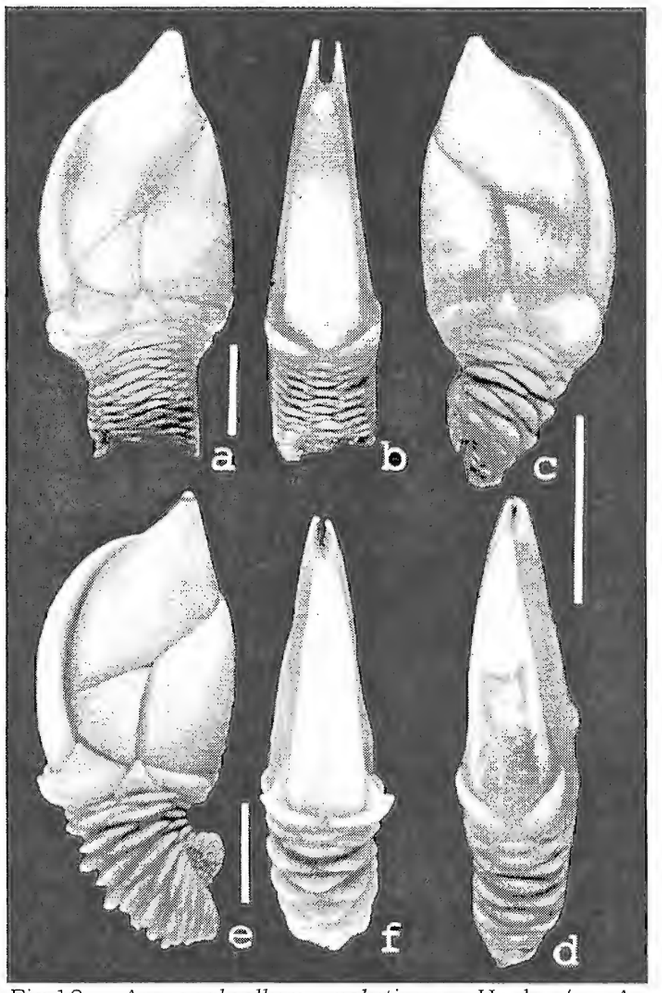

Fig.13- *Arcoscalpellum velutinum* Hoek (= *A. michelottianum*), Types: a-b) lateral and carinal views from Challenger (St. 355), c-d) lateral and carinal views from Challenger (St. 111). *A. michelottianum* (Seguenza), e-f) lateral and carinal views (St. M36 - 98, AT 149). Bar: 10mm.

Subfamily Arcoscalpellinae Zevina, 1978

Genus *Arcoscalpellum* Hoek, 1907

Arcoscalpellum michelottianum (Seguenza, 1876)

(Figs.13a-d, 14)

Scalpellum michelottianum Seguenza, 1876:381, pl.6, figs.15-25, pl.10, fig.26..

Scalpellum velutinum Hoek, 1883:96, pl.4, figs.10-11, pl.9, figs.7-9.

Arcoscalpellum michelottianum: NEWMAN & ROSS, 1971:71, text-fig.34, pl.9b (synonymy).

Material – Eastern Atlantic. 37°39.0'N, 09°32.0'W, 1430-1370m, 29 spec, SM; 33°34.2'N, 09°19.3'W, 1300m, 56 spec, SM; St. M36 - 98, AT 149; Meteor seamounts, without detailed locality, 2 spec, SM.

Types of *Scalpellum velutinum* Hoek, 1883. 'Challenger', St. 335, 32°24'S, 13°5'W, 1425 fathoms (2606m), 1 spec, BM, unnumbered; St. 111, 37°2'N, 9°14'W, 900 fathoms (1646m), 3 spec, BM, unnumbered.

Remarks – The specimens I examined (Figs.13e-f) agree with the description of *Scalpellum velutinum* Hoek (1883) (=*S. michelottianum*) from "near Cape St. Vincent" and "north of Tristan da Cunha" (Figs.13a-d). The tectum of the carina is flat, with a ridge at the border; the basis of the carina is square, between the carino-latera, and the carino-latus is recurved and has an outward projecting umbo. The specimens examined average smaller then those observed by HOEK (1883) and PILSBRY (1907a), with specimens from a few millimeters to 3cm in capitulum length. Only the two specimens from St. M36 were fully developed and have a capitular length of 33 and 34mm. The specimens ranged from 11 to 58mm in total length (capitulum length 6 to 34mm).

The pilose cuticle is conspicuous, but in some specimens it is restricted to the spaces between the plates.

A. michelottianum apparently has a world wide distribution but this warrants further study. Records of this species from the Atlantic ocean are presented in figure 14.

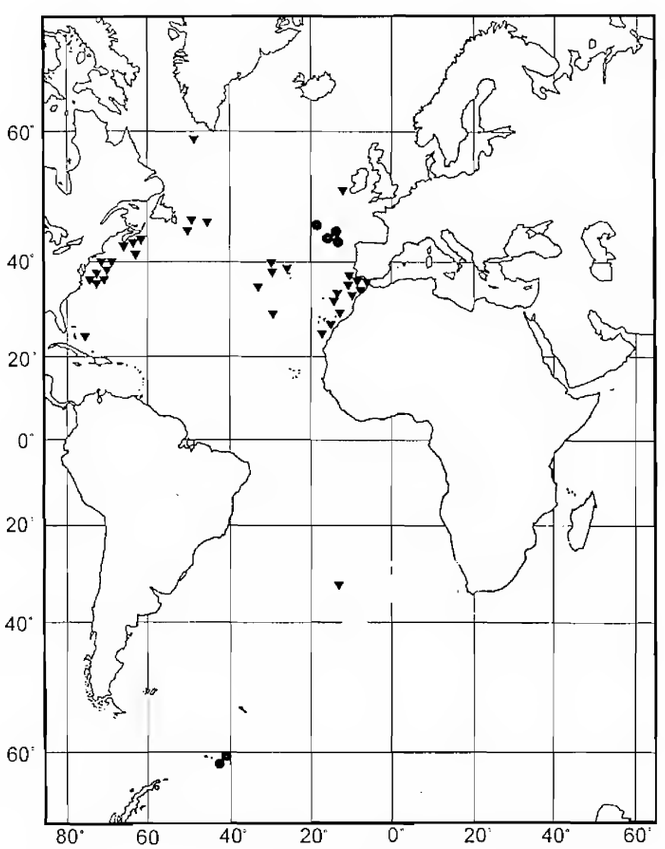

Fig.14- Geographic distribution: (▼) *Arcoscalpellum michelottianum* (Seguenza) (only Atlantic records), (●) *Planoscalpellum limpidus* (Zevina).

Arcoscalpellum tritonis (Hoek, 1883)

(Figs.15a-j, 16)

Scalpellum tritonis Hoek, 1883:122, pl.V, figs.9-10, pl.X, fig.10.

Scalpellum tritonis: HOEK, 1884:4; PILSBRY, 1907a:34; BROCH, 1953:4.

Arcoscalpellum tritonis: NEWMAN & ROSS, 1971:60; ZEVINA, 1978:1350; 1981a:342, fig.342.

Material – Eastern Atlantic. 37°39.0'N, 09°32.0'W, 1430-1370m, 16 spec, SM; 33°34.2'N, 09°19.3'W, 1300m, 1 spec, SM.

Description – Capitulum (Figs.15a-c) covered by a thin cuticle; length less than twice its width, relatively swollen at medio-basal portion; carinal margin more convex than occludent. Plates with thin growth lines and without longitudinal ridges.

Tergum (Fig.15a) triangular, all margins straight, occasionally occludent margin slightly convex, with its surface area larger than scutum.

Scutum (Fig.15a) convex with an apico-basal ridge; length twice the width; tergal margin smaller than basal, both essentially straight; lateral margin convex, occludent margin convex to straight; apex curved slightly, extending over tergum.

Carina (Figs.15a-b) regularly arched, with a flat tectum angularly sided by a lateral border, basal margin rounded, occasionally obtusely triangular. Small cuticular area present between carina and tergum.

Upper-latus (Fig.15a) pentagonal. Scutal margin longest, concave; all other margins straight, with tergal and carino-lateral margins of equal length.

Carino-latus (Fig.15a-b) pentagonal, significantly higher than wide, umbo near base of carina basis and projecting from carinal outline; with a conspicuous ridge from umbo to basal angle. Plates contiguous under carina, forming a loose interlock.

Inframedian latus (Fig.15a) triangular, higher than wide, apex straight or sometimes turned forward.

Rostro-latus (Figs.15a, c) wider than high, with a conspicuous apico-basal ridge dividing plate, one more lateral, the other more basal; basal and scutal margins slightly divergent from carina, the later larger.

Rostrum (Fig.15c) a vertical strip, covered laterally by rostro-latera.

Peduncle (Fig.15a) short, length less than 1/3 height of capitulum, covered by conspicuous laterally lengthened scales.

Labrum lacking teeth. Palp (Fig.15d) small, acuminate, with numerous large setae on distal extremity. Mandible (Fig.15e) with three acute teeth and a denticulated lower angle; distance between first and second teeth twice distance between second and third. Cutting edge of maxilla I (Fig.15f) straight, with three large spines at upper angle and 7-9 moderate to small spines directed downwards. Maxilla II (Fig.15g) nearly triangular with setae along its margins; maxillary gland projecting prominently.

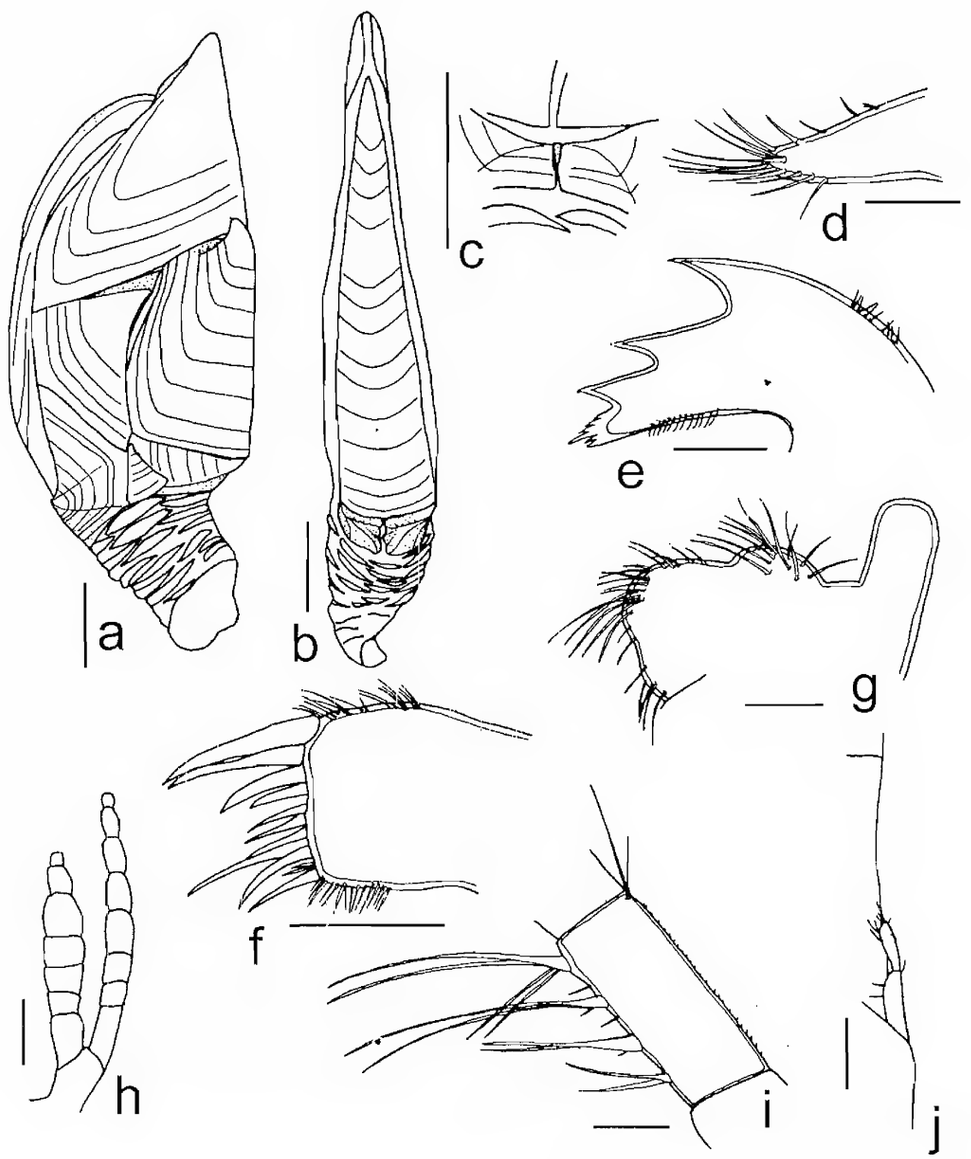

Fig.15- *Arcoscalpellum tritonis* (Hoek) (St. 8-8, AT6): a) lateral view, b) carinal view, c) rostral view, d) palp, e) mandible, f) maxilla I, g) maxilla II, h) outline of cirrus I, i) median article of cirrus VI, j) caudal appendage. Bar: a-c) 2mm; d-j) 0.2mm.

Cirrus I (Fig.15h) with shorter ramus 4/5 length of longer; articles slightly protuberant, clothed with numerous simple setae. Cirri II-VI with equal rami, intermediate articles (Fig.15i) about twice as long as wide, with 4 pairs of simple setae and scattered small setae on anterior margin, 1-2 setae on posterior angle and numerous scales along posterior margin.

Caudal appendage (Fig.15j) biarticulate with a tuft of setae at distal end, and a few setae sparsely scattered along its length; length less than one-half of first basal article.

The specimens varied from 6 to 14mm in total length (capitulum length 4 to 12mm).

Remarks – The specimens agree with the description of HOEK (1883), except that he did not report a rostrum in his specimens. The rostrum of the present specimens are easily distinguished. The distribution of this species is extended southward to off Morocco (Fig.16).

Genus *Planoscalpellum* Zevina, 1978
Planoscalpellum limpidus (Zevina, 1976)
(Figs.14, 17a-k)

Scalpellum limpidus Zevina, 1976:1152, fig.2.
Planoscalpellum limpidus: ZEVINA, 1978:1347; 1981a: 187, fig.131; 1993:125.

Material – Eastern Atlantic. 42°17,2'N, 14°46,3'W, 5270m, 3 spec, SM; 42°55,4'N, 14°07,9'W, 5260m, 1 spec, SM; 42°04,1'N, 14°55,6'W, 5275m, 2 spec, SM.

Description – Capitulum (Figs.17a-c) with length twice width, flattened; covered by a thin cuticle. Plates thin, with inconspicuous growth lines and without longitudinal striae.

Scutum (Fig.17a) triangular, basal and lateral margins continuously curving, surface curving slightly at occludent area. Apex little curved extending over tergum. Occludent margin straight, except at curved apex; tergal margin straight, usually thickening toward apex; lateral margin concave at upper portion and convex at lower part.

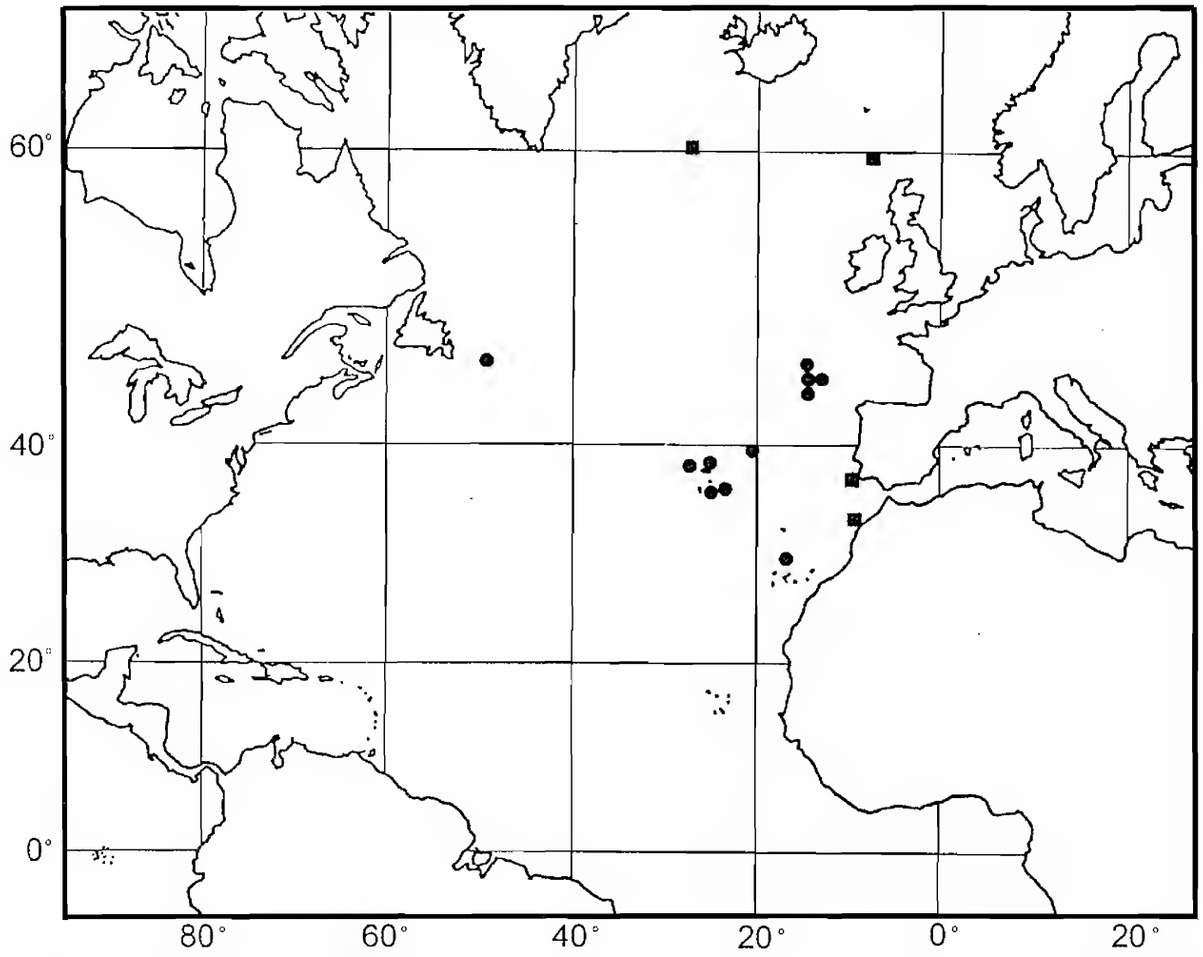

Fig.16- Geographic distribution: (■) *Arcoscalpellum tritonis* (Hoek), (●) *Amigdoscalpellum rigidum* (Aurivillius).

Tergum (Fig.17a) triangular, larger in surface area than scutum. Apex straight. Occludent margin slightly convex, basal nearly straight, and carinal irregular, thickening toward apex of carina, convex at lower part.

Carina (Figs.17a-b) continuously curved, thicker apically. Tectum flat, basal margin rounded.

Upper-latus (Fig.17a) pentagonal, occupying about same area as scutum, umbo at center of scutal margin. All margins nearly straight, except scutal, which is undulate.

Rostrum (Fig.17c) small, heart-shaped, between rostro-latera and scuta and covered by former.

Rostro-latus (Figs.17a, c) higher than wide. Umbo slightly projecting from outline of capitulum. Basal margin one-half length of scutal margin; inframedian margin convex.

Inframedian latus (Fig.17a) wineglass-shaped, with umbo slightly above center. Upper region depressed, except for a thin, long scutal crest.

Carino-latus (Figs.17a-b) high, 1.5 times higher than wide; pentagonal, with umbo below base of carina, slightly projecting outwards; carino-latera in contact with one another, but not interdigitating.

Peduncle (Fig.17a) about 1/3 height of capitulum, totally covered by numerous small and conspicuous scales, which project outwards at upper surface.

Labrum (Fig.17d) lacking teeth. Palp (Fig.17d) short, acuminate, with few setae. Mandible (Fig.17e) with four sharp teeth and a denticulated lower angle. Maxilla I (Fig.17f) small with border slightly concave in middle, with two large spines at upper angle and 5-7 medial unpaired spines directed downwards. Maxilla II (Fig.17g) nearly square, covered by numerous large simple setae; maxillary gland pronounced.

Cirrus I (Fig.17h) with subequal rami, shorter ramus about 4/5 length of longer. Articles little protuberant, covered by numerous simple setae; distal articles of both rami with long, slightly pinnate setae (Fig.17i). Cirri II to VI with equal rami; medial articles (Fig.17j) of posterior cirri with four pairs of simple setae on anterior margin, and one or two small setae on posterior angle. Number of articles presented in table 2.

Caudal appendage (Fig.17k) long, multiarticulate (9), length nearly twice length of basal article of cirrus VI; articles with few setae on distal margins and two large thin feathered setae on distal article.

The specimens varied from 14 to 19mm in total length (capitulum length 12 to 14mm).

TABLE 2

NUMBERS OF ARTICLES ON CIRRI I-VI, AND CAUDAL APPENDAGES OF *PLANOSCALPELLUM LIMPIDUS*

	CI	CII	CIII	CIV	CV	CVI	CA
RC	9/11	16/20	21/22	20+/22	25/22+	24+/26+	9
LC	9/11	16/20	22/24	19+/23	26/19+	27/9+	9

(CI-VI) cirri I to VI; (CA) caudal appendage; (RC) right cirri; (LC) left cirri; (+) broken ramus

Remarks – ZEVINA (1976) described this species from northeast of the Azores, at depths of 5001-5900m, and later (1993) recorded it from near the South Orkney Islands, Antarctica, from 5063-5580m (Fig.14). The present specimens agree in general with her description (ZEVINA, 1976; 1981a) and occur at the same depth (5260-5275m). The single specimen dissected by ZEVINA (1976) had seven articles in the caudal appendage instead of 9 as in the present specimens. Further, the rostrum figured is smaller and not covered by the rostro-latera. The specimens studied by ZEVINA (1993) from Antarctica were not described in detail.

ZEVINA (1976; 1993) compared the general appearance of this species with *P. hexagonum* (Hoek) from the Pacific, but the latter does not have a rostrum; the inframedian latus has an apical umbo; the caudal appendage has only 5 articles and its length equals the length of the protopod (HOEK, 1907a).

Genus *Verum* Zevina, 1978

Verum parazelandiae n.sp.

(Figs.6, 18a-l)

Scalpellum Novae-Zelandiae: GRUVEL, 1902a:54, pl.II, fig.12, 13 and 15.

Verum novaezelandiae: FOSTER & BUCKERIDGE, 1995a:174, fig.7C-E (in part: specimens from Atlantic).

Material – Eastern Atlantic. HOLOTYPE: 1 Female, St. 8-8, AT6, 20.01.67, 37°39.0'N, 09°32.0'W, 1430-1370m, SM. PARATYPES: 7 females from the same locality, SM, USNM 274311.

Diagnosis – Capitulum with occludent margin slightly convex in small specimens and straight in larger ones. Inframedian latus vase-shaped, umbo slightly above basal margin. Rostrum small, rectangular. Rostro-latus wider than high. Caudal appendage with 3 articles, 2/3 length of coxal article of cirrus VI.

Description – Capitulum (Figs.18a-c) flattened, length less than twice width, covered by a thin cuticle. Carinal margin convex, and occludent slightly convex in small specimens and straight in larger ones. Plates with inconspicuous growth lines and lacking longitudinal striae.

Scutum (Fig.18a) triangular, with lateral margin convex, tergal and occludent straight; a narrow ridge parallels tergal margin. Apex curved, slightly extending over tergum.

Tergum (Fig.18a) triangular, its surface area a little greater than that of scutum. Apex recurved. Occludent margin straight, slightly convex near apex; basal margin nearly straight; carinal margin convex basally, concave apically.

Carina (Figs.18a-b) continuously curved, equally thick throughout its height, apex between terga. Tectum flat. Basal margin rounded and displaced more apically, leaving a large space occupied by carino-latera.

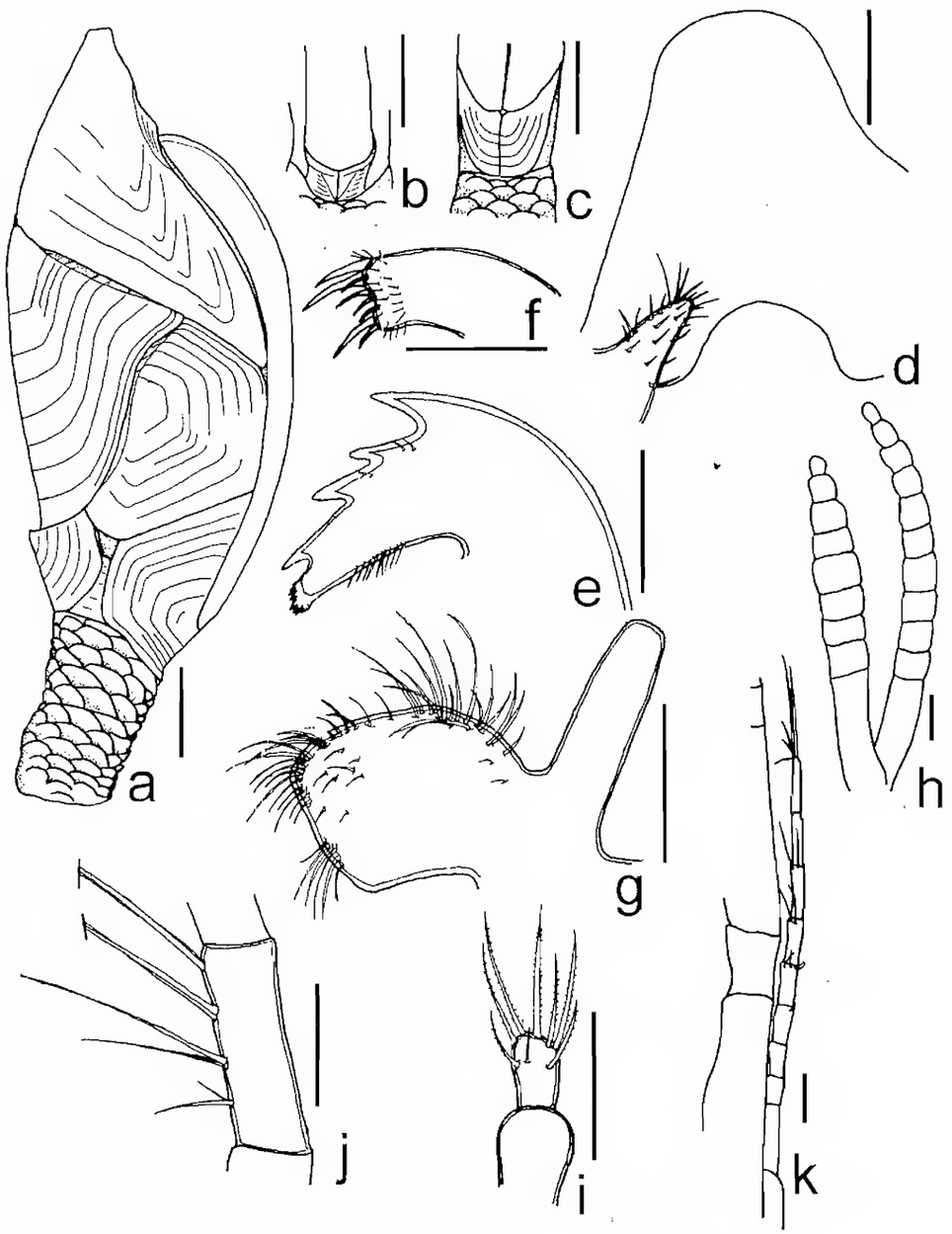

Fig.17- *Planoscalpellum limpidus* (Zevina) (St. 3-24): a) lateral view, b) carinal view, c) rostral view, d) labrum and palp, e) mandible, f) maxilla I, g) maxilla II, h) outline of cirrus I, i) distal article of posterior ramus of cirrus I, j) median article of cirrus VI, k) protopodite of cirrus VI and caudal appendage. Bar: a-c) 2mm; d-k) 0.3mm.

Upper-latus (Fig.18a) trapezoidal, with a conspicuous triangular projection at distal tergal margin. All margins essentially straight, except scutal, which is concave.

Rostrum (Fig.18c) small, rectangular, with a ridged central area, covered laterally by rostro-latera.

Rostro-latus (Figs.18a-c) wider than high. Umbo at scutal angle, with a conspicuous apico-basal ridge. Basal margin nearly parallel to scutal margin and of same length.

Inframedian latus (Fig.18a) vase-shaped, umbo slightly above basal margin. Upper portion enlarged, with a slight ridge from umbo to apical angle.

Carino-latus (Figs.18a-b) 1.5 higher than wide; nearly triangular, umbo basal, projecting posteriorly. Plates contiguous under carina, forming a large interlock. Carinal margin straight.

Peduncle (Fig.18a) less than 1/3 length of capitulum, covered by a few small laterally lengthened scales.

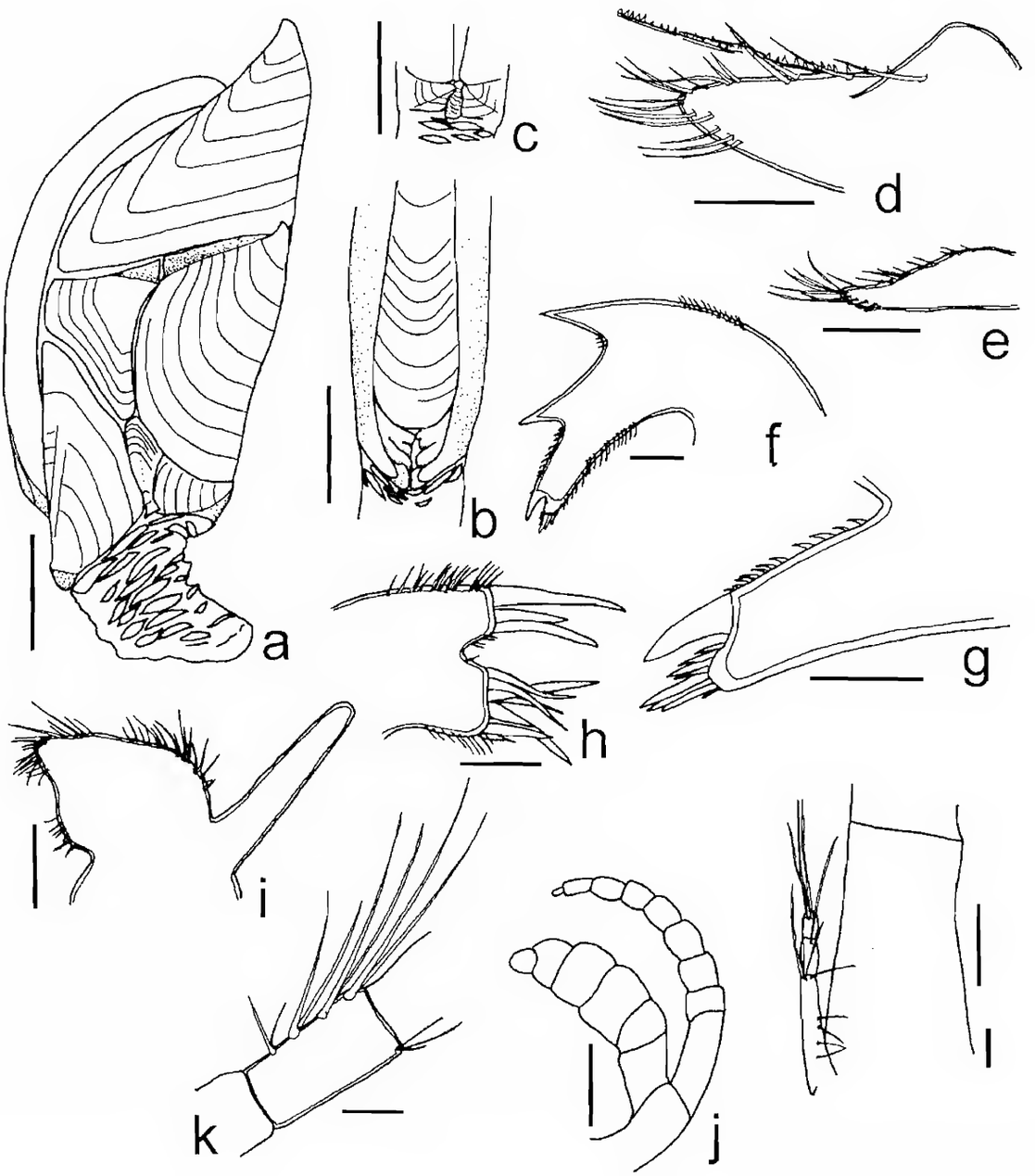

Fig.18- *Verum parazelandiae* n.sp., Holotype: a) lateral view, b) carinal view, c) rostral view; Paratype: d) labrum and palp, e) palp, f) mandible, g) detail of lower angle of mandible, h) maxilla I, i) maxilla II, j) outline of cirrus I, k) median article of cirrus VI, l) caudal appendage. Bar: a-c) 2mm; d, g-h) 0.1mm; e-f, i, l) 0.2mm; j-k) 0.5mm.

Labrum (Fig.18d) bullate, crest with a row of small teeth. Palp (Figs.18d-e) reaching middle part of labrum, acuminate, clothed with large simple setae sparsely distributed. Mandible (Figs.18f-g) with three acute teeth, third tooth near lower angle, upper margin of third tooth with small denticles; lower angle acutely denticulate. Maxilla I (Fig.18h) with a deep triangular notch near center of cutting edge; upper border of the cutting edge with three strong large spines and lower border with 8 medial to small unpaired spines. Maxilla II (Fig.18i) triangular, anterior margin slightly concave and posterior convex; with numerous simple setae; maxillary gland projecting.

Cirrus I (Fig.18j) with unequal rami, shorter ramus 4/5 length of longer, with protuberant articles; both rami covered by numerous large simple setae. Cirrus II with subequal rami; cirri III to VI with equal rami. Medial articles (Fig.18k) of cirrus VI about twice as high as wide, clothed with four pairs of simple setae on anterior margin and 1-3 simple setae at posterior angle.

Caudal appendage (Fig.18 l) of 3 articles, 2/3 of length of first basal article of cirrus VI; proximal article longer than others; articles with large simple setae on distal margins, proximal also with small setae on anterior margin.

The capitulum of the holotype is 10mm in length and 14mm overall. The paratypes ranged from 7 to 12mm overall length (capitulum length 6 to 9mm).

Etymology – from the Greek *para* (near) and Zealand, referring to its similarity to *Verum novazelandiae.*

Remarks – This species is very similar to *Verum novaezelandiae* (Hoek, 1883), which was originally described from New Zealand, and later recorded from numerous localities in the Indomalasian region. GRUVEL (1902a) identified specimens from the northeastern Atlantic as *S. novaezelandiae*, commenting that his specimens had few differences. The specimens he examined had 7-8 articles on each caudal appendage. FOSTER & BUCKERIDGE (1995a) also recorded *V. novaezelandiae* from the northeastern Atlantic.

V. novaezelandiae has a convex occludent margin; the rostrum is horn shaped; the scutum does not have a flange near the tergal margin; the rostro-latus is as high as wide (in fig.7, pl.V of HOEK, 1883) or higher than wide (see FOSTER, 1978); the inframedian latus has a more central umbo, having an hour-glass appearance (HOEK, 1883; FOSTER, 1978). ZEVINA (1981a) figured an uniarticulated caudal-appendage for this species, but FOSTER (1978) and ZEVINA (1981b) cited a caudal appendage of up to six articles.

I included the citations of *V. novaezelandiae* by GRUVEL (1902a) and FOSTER & BUCKERIDGE (1995a) from the Atlantic, in the synonymy of *Verum parazelandiae* n.sp., which has a distribution restricted to the Northeastern Atlantic (Fig.6).

Genus *Amigdoscalpellum* Zevina, 1978

Amigdoscalpellum rigidum (Aurivillius, 1898)

(Figs.16, 19a-m)

Scalpellum rigidum Aurivillius, 1898:189.

Scalpellum rigidum: GRUVEL, 1905:86; ZEVINA, 1976:1155.

Scalpellum striatum Gruvel, 1900a:191.

Scalpellum striatum: GRUVEL, 1902a:77, pl.II, fig.3I; 1905:72, fig.81; 1920:23, pl.II, figs.4-6, 9-11; pl.VII, fig.11; NILSSON-CANTELL, 1955:219; BELLOC, 1959:3.

Amigdoscalpellum rigidum: ZEVINA, 1978:1349; 1981a:277, fig.209.

Material – Eastern Atlantic. 42°55.4'N, 14°07.9'W, 5260m, 77 spec, SM; 42°38.5'N, 13°31. 0'W, 5318m, 5 spec, SM; 42°17.2'N, 14°46.3'W, 5270m, 94 spec, SM; 42°04.1'N, 14°55.6'W, 5275m, 22 spec, SM.

Description – Capitulum (Figs.19a-c) twice as long as wide, covered by a thin cuticle. All plates with strong longitudinal striae and widely spaced growth lines.

Scutum (Fig.19a) rectangular, twice as long as wide, apex slightly extending over tergum, and with a distinct apico-basal ridge, umbo recurved. Occludent margin convex others essentially straight.

Tergum (Fig.19a) triangular, length twice its width, apex straight, but usually eroded. Occludent and basal margins straight, carinal concave at upper half and convex at lower half.

Carina (Figs.19a-b) continuously curved, expanding slightly toward apex. Tectum slightly convex, bordered by low ribs; basal margin rounded.

Upper-latus (Fig.19a) trapezoidal, all margins essentially straight, scutal and tergal, longest and same length, followed by carino-lateral and carinal margins.

Rostrum visible only in small specimens as a long and thin strip between rostro-latera.

Rostro-latus (Figs.19a, c) higher than wide, umbo not projecting from capitulum outline; with a divergent straight basal and scutal margins, and a convex inframedian margin.

Inframedian latus (Fig.19a) changing in size during development. Small specimens with height equal to adjoining lateral plates and higher than wide; larger individuals with height reduced to one-half that of other lateral plates, and only a little higher than wide.

Carino-latus (Figs.19a-b) 1.5 times higher than wide; pentagonal, with umbo below base of carina, projecting slightly; basally both carino-latera meet, forming a large interdigitating area.

Peduncle (Fig.19a) less than 1/4 of capitulum length, covered by laterally elongated scales.

Labrum (Fig.19d) with one row of simple or bifid denticles. Palp (Figs.19d-e) small, acuminate, with large simple setae sparsely distributed. Mandible (Fig.19f) with three sharp teeth; distance between 1 and 2 twice distance between 2 and 3, and with a denticulated lower angle. Maxilla I (Figs.19g-h) with three large spines on upper angle, followed

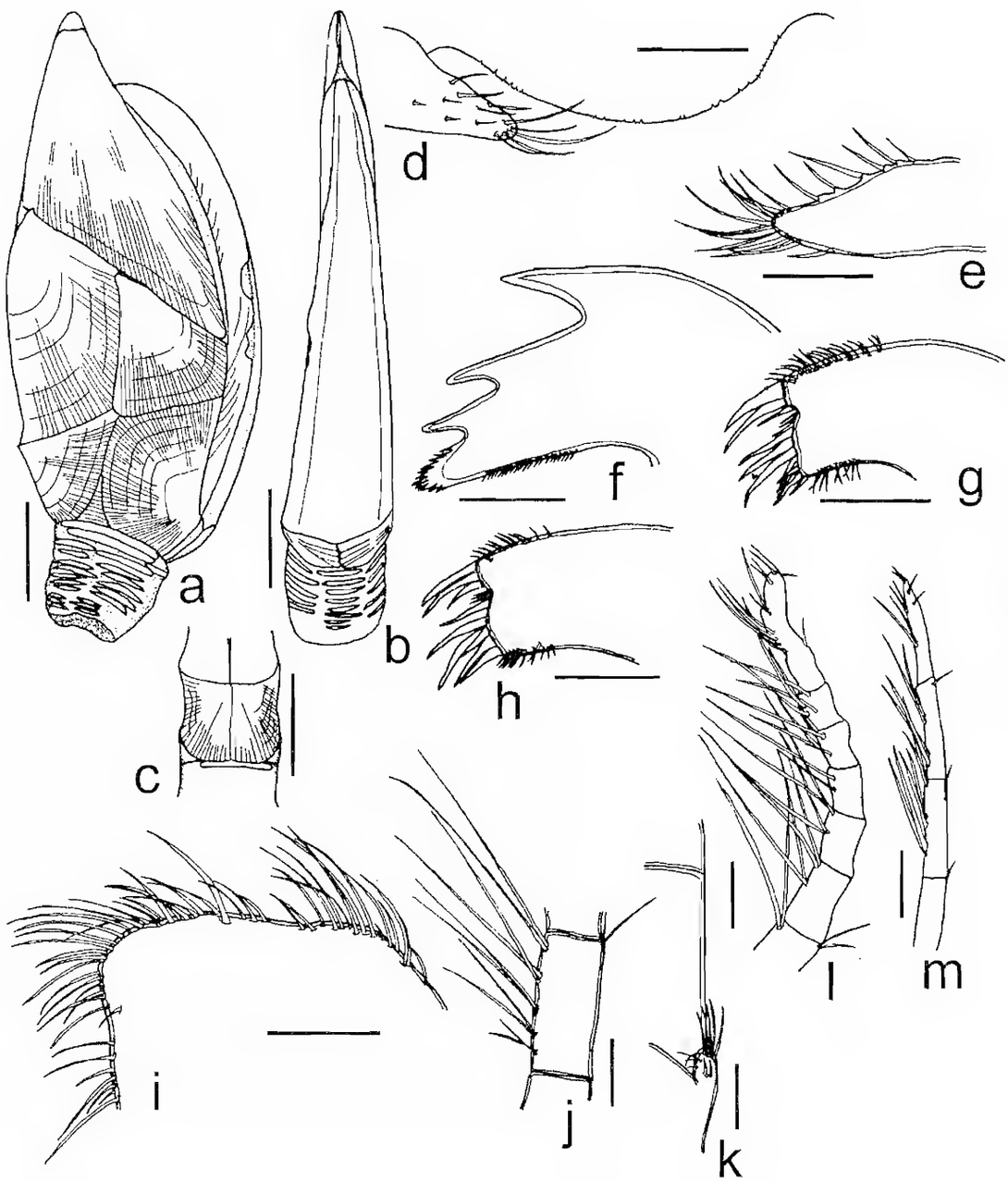

Fig.19- *Amigdoscalpellum rigidum* (Aurivillius) (St. 3-24): a) lateral view, b) carinal view, c) rostral view, d) labrum and palp, e) palp, f) mandible, g-h) maxilla I, i) maxilla II, j) median article of cirrus VI, k) caudal appendage, l-m) abnormal and normal distal portion of cirrus V. Bar: a-c) 5mm; d-i) 0.3mm; j-k) 0.5mm; l-m) 0.1mm.

occasionally a small, poorly defined shallow notch, and 7-12 unpaired large to small spines. Maxilla II (Fig.19i) square, anterior margin slightly concave and posterior margin convex; clothed with numerous simple setae.

Cirrus I with unequal rami, shorter ramus 1/3 length of longer ramus; shorter ramus with protuberant articles covered by numerous simple setae; longer ramus with slightly protuberants articles and numerous simple setae. Cirri II to VI essentially equal in length, median articles (Fig.19j) with 5 pairs of setae and 1-2 setae on posterior angle.

Caudal appendage (Fig.19k) uniarticulate, 1/3 length of first basal article of cirrus VI, covered by simple setae.

The specimens ranged from 5 to 31mm in overall length (capitulum length 4 to 26mm).

Remarks – *Scalpellum rigidum* ranges from 36-46°N and 20-49°W between 1267 and 4400m. The specimens collected during the "Campagnes Scientifiques de S. A. S. le Prince de Monaco" were briefly described by AURIVILLIUS (1898) who did not state that they have a rostrum. GRUVEL (1900a) described from the same area *Scalpellum striatum*, which differs from *S. rigidum* by having a rostrum.

GRUVEL (1920) reexamined the specimens described by Aurivillius, and noted that the absence of a rostrum was overlooked by Aurivillius. Without any discussion GRUVEL (1920) considered *S. rigidum* to be a junior synonym of *S. striatum*, despite the fact that *rigidum* has priority. This name was used later by NILSSON-CANTELL (1955), but without considering the rule of priority.

There are differences in the geographic coordinates from the same stations cited by AURIVILLIUS (1898) and GRUVEL (1920). I have maintained the first citation in the map presented herein (Fig.16).

NILSSON-CANTELL (1928) noted that *S. rigidum* was probably the same as *S. elongatum* Hoek (= *S. costellatum* Withers) from Tristan da Cunha and numerous localities from the Pacific and Indian Oceans. Some of the characters cited in the description of Hoek from the material examined: the carina has a tectum deeply furrowed, which is bordered by strong lateral ridges, the upper-latus is trapezoidal, and the carino-latus projects from the capitulum in a carinal view (HOEK, 1883: pl.IV., fig.9). Otherwise, the highly striated valves and the variable shape of the rostrum and inframedian latus are the same in both species.

The appendages of *S. rigidum* were not described previously. The specimens dissected are not conspicuously different from those appendages of *S. elongatum* described by NILSSON-CANTELL (1928).

The large specimens dissected (St3-24) had parasite isopods present between their cirri in some individuals. The tips of the cirri, where apparently these animals attach, were deformed (Figs.19 l-m).

Amigdoscalpellum was proposed by ZEVINA (1978) to encompass those species of *Arcoscalpellum s.l.* with a reduced triangular inframedian latus, *i.e.* the length does not reach the upper outline of the lower plates and it is lower than the rostro-latus and carino-latus. This character is not stable in *A. rigidum* because small specimens have an inframedian latus as high as the other lateral plates, only being reduced in larger specimens (capitulum length >20mm).

Genus *Trianguloscalpellum* Zevina, 1978

This genus was proposed by ZEVINA (1978) to include species with an inframedian latus and carino-latus which have an apical umbo, and both of which are usually triangular. In addition the species have long caudal appendages.

The apical position of the umbo in the inframedian and carino-latus are a plesiomorphic character, still present in many other genera like *Scillaelepas*, *Pollicipes* and *Smilium*. The multiarticulated caudal appendage, appears to be derived, but it is still present in other genera. Therefore, *Trianguloscalpellum* may encompass many species that are probably not related. In examining many species from the Atlantic and Pacific I had to return to PILSBRY's (1907a) views of the *Scalpellum* groups. The group of *Scalpellum velutinum* appears to form a natural group, the characters that unite this group are the large size of the specimens (usually more than 3cm in capitulum length), and a well developed cuticle that is usually pilose. In this group two trends may be observed: (1) displacement of the apical umbo of the carino-latus to a posterior position and (2), reduction of the plates coverage of the capitulum.

In the first situation the change can be observed through the transformation of the carino-latus from *T. ovale/gigas*, to *T. regium/darwinii*, to *L. henriquecostai*, *L. regina*, and *A. michelottianum*. The second is from species with well developed plates to species with reduced plates - *L. regina*, *L. henriquecostai* and *L. giganteum*.

For the present, I cannot propose another classification, because a detailed study on the evolution of the Scalpellidae is necessary before an extensive review of its classification. Herein I

include a key for the "large" Atlantic species, and some related Pacific species discussed herein.

1 Plates developed, covering all the capitulum 2
Plates reduced, not covering all the capitulum 7

2 Carino-latus higher than wide, without a flange at upper margin 3
Carino-latus higher than wide, with a flange at upper margin 4

3 Tectum of carina rounded with lateral margin continuously, scales of peduncle projecting beyond the cuticle..... *Trianguloscalpellum ovale*
Tectum of carina flat with lateral margin angular, scales of peduncle imbedded in a thick cuticle ..... *T.gigas* (Pacific)

4 Carino-latus with umbo apical, apex not projecting... 5
Carino-latus with umbo posterior, apex projecting posteriorly ..... *Arcoscalpellum michelottianum*

5 Length of carino-latus much larger than inframedian latus and rostro-latus 6
Length of carino latus same as inframedian latus and rostro-latus..... *T.mollucanum* (Pacific)

6 Tectum of carina slightly angular or flat, occasionally with low bordering ribs, peduncle less than length of capitulum ..... *T. regium*
Tectum of carina rounded, without ribs, peduncle equal to or longer than length of capitulum ..... *T.darwinii* (Pacific)

7 Tectum of carina flat; umbo of carino-latus projecting from the capitulum surface 8
Tectum of carina rounded; umbo of carino-latus not projecting ..... *Litoscalpellum giganteum*

8 Tectum of carina without bordering ribs ..... *L.regina*
Tectum of carina with conspicuous bordering ribs ..... *L.henriquecostai*

Trianguloscalpellum regium (Wyville-Thomson, 1873)
(Figs.20a-h, 22)

Scalpellum regium Wyville-Thomson, 1873:347 [description only, not figs.1-2 = *Trianguloscalpellum ovale* (Hoek, 1883)].

Scalpellum regium: WYVILLE-THOMSON, 1877:4 [not figs.2-3, = *T. ovale*]; HOEK, 1883:106, pl.IV, figs.3-5, pl.IX, fig.12, pl.X, figs.1-2; 1884:10; PILSBRY, 1907a:28, pl.III, fig.5 [in part, not pl.III, fig.4 = *T. ovale* (Hoek, 1883)] –; GRUVEL, 1912a:2; 1920:30, pl.I, fig.7.

Scalpellum molle Aurivillius, 1898:191.

Scalpellum molle: GRUVEL, 1905:77; 1920:29, pl.V, figs.10-12; NILSSON-CANTELL, 1955: 218; BELLOC, 1959:3; ZEVINA, 1976:1155; 1981:309.

Trianguloscalpellum regium: ZEVINA, 1978:1350; FOSTER & BUCKERIDGE, 1995a:167, figs.2A-D, 3.*Trianguloscalpellum regium regium* - ZEVINA, 1981a: 309, fig.234.

not *Scalpellum regium*: ZEVINA, 1970:263, pls. 10-11; 1973:136 [=*Trianguloscalpellum ?gigas* (Hoek, 1883)].

not *Trianguloscalpellum regium*: ZEVINA, 1981b:86; FOSTER & BUCKERIDGE, 1995b:355, fig.6K [= *Trianguloscalpellum? mollucanum* (Hoek, 1883)].

Material – Eastern Atlantic. 42°17.2'N, 14°46.3'W, 5270m, 1 spec, SM.

Types - "Challenger", sta. 61, 34°54'N, 56°38'W, 2850 fathoms (5212m), 2 spec, BM, unnumbered.

Emended diagnosis – Capitulum with 14 valves. Carina simply arched, tectum with a slight elevation medially or flat with low bordering ribs, laterals small. Umbo of carina at apex. Carino-latus as high as wide, with two apico-basal ridges, both plates meeting in an area below carina. Upper-latus triangular. Peduncle short, slightly more than 1/2 length of capitulum.

Description – Capitulum (Figs.20a-h) with 14 plates, slightly swollen. Cuticle thin, pillose, and with small protuberances. Carinal margin more convex than occludent. Spaces between plates filled by thick cuticle with the spaces between carina and tergum somewhat greater than between other plates.

Scutum (Figs.20b, d, g) broad, its length almost twice its width, surface convex, with an apicobasal ridge. Occludent margin almost straight, lateral margin convex, scutal and basal margins straight. Umbo at apex.

Tergum (Figs.20c, f, g) with greater surface area than scutum. Apex nearly straight. Occludent margin straight, carinal and scutal margins similarly arched. Basal angle pointed.

Carina (Figs.20a-b, d-e, g-h) uniformly arched, apex extending to 2/3 length of tergum. Tectum either elevated medially or flat, lateral margin with low longitudinal ribs, laterals narrow. Basal margin V-shaped.

Upper-latus (Figs.20b, d, g) essentially triangular; basal margin convex, tergal straight, and scutal margin concave.

Rostrum covered by rostro-latera, visible as a long, lengthened, rounded area between rostro-latera; umbo apical.

Rostro-latus (Figs.20b, d, g) trapeziform, scutal and basal margins parallel, the former twice length of latter; having a conspicuous apico-basal ridge.

Inframedian latus (Figs.20b, d, g) triangular, equilateral with apical umbo, projecting over scutum.

Carino-latus (Figs.20a-b, c-d, g-h) as high as wide. Umbo at apex, slightly curved, with two conspicuous apico-basal ridges. Both plates meeting under carina in a narrow line. Where plates meet length about 1/4 length of carino-latus.

Peduncle (Figs.20b, d, g) slightly greater than 1/2 length of capitulum, with laterally elongated scales, slightly imbedded in cuticle.

The specimen had a total length of 67mm (capitulum length 41mm).

Remarks – I have reexamined the types of *Scalpellum regium* Wyville-Thomson, 1873, *S. regium ovale* Hoek, 1883 and *S. gigas* Hoek, 1883 in order to decide which species are valid.

The characters that distinguish the subspecies *S. regium ovale* from *S. regium regium* are remarkable and justify their separation at the specific level. Both species were taken at the same Challenger station (St. 61). These two species (at subspecies level) were proposed by HOEK (1883) during his study of the Challenger cirriped collections. Unfortunately, WYVILLE-THOMSON (1873) did not recognize that he had a sample containing more than one species. This confusion is evident in his paper of 1873 (and repeated in 1877) where he did a detailed description of *S. regium* but depicted a specimen of *S. regium ovale*.

HOEK (1883) inferred that *ovale* was only a subspecies of *T. regium*. He also inferred that many characters found in *ovale* were due to their stage of development. When he described the differences between *ovale* and *regium* he stated that: "The carino-latus is a great deal larger; higher in the first place. Moreover, the ridges which divide the same valve in *Scalpellum regium* into distinct triangles are by no means so distinct in the variety". The distinctions between the shape of the carino-latus are remarkable in both species: *T. regium* has the carino-latus as high as wide and *T. ovale* has it higher than wide. Additionally, *T. ovale* has a wider area of contact between the carino-latera. Otherwise, HOEK (1883) described the carina of *S. regium ovale* as having "the sides almost undeveloped" which is constant in the large specimen of the present sample.

The difficulty in distinguishing this species was noted by PILSBRY (1907a). In the samples taken by the "Albatross" from the Western Atlantic, both of which were collected, and notwithstanding the differences between them, Pilsbry identified both as *S. regium*. He also noted that the specimens from a gorgoniam stem had a distinct cuticle and "the two carino-latera are in contact only near the basis, for a space of 2.5mm (*T. regium* specimen, fig.5), while in the other specimen they are in contact for 7mm" (*T. ovale* specimen, fig.4).

GRUVEL (1912a; 1920) also recorded *T. regium* from the area of the Azores during the Campagnes Scientifiques de Monaco, but in the samples taken by the "Talisman" and "Travailleur" (GRUVEL, 1902a) he considered the specimens of *T. ovale* he had as *S. gigas*, a species described by HOEK (1883) from the middle of the North Pacific.

T. ovale, from the Atlantic, is similar to *T. gigas* from the Pacific, which are difficult to distinguish by the shape of carino-latus. Even the general appearance of the capitulum is very similar. Examining the type of both species and samples from the Eastern Atlantic and Eastern Pacific, I could differentiate both species based on the shape of carina. The first has a well arched carina, with a small lateral border continuous with the convex tectum; the second has also a well arched carina, with a small lateral border, but conspicuous, and separated from the flat tectum by an angle. The peduncular scales from *T. ovale* project beyond the cuticle instead of being totally immersed in the cuticle as they do in *T. gigas*. Otherwise, the upper-latus of *T. gigas* has a more quadrangular shape instead of a triangular shape such as that of *T. ovale*.

On the other hand, *T. regium* and *T. darwinii*, from the Eastern Pacific, are also similar but they can be distinguished by the distinct shape of the tectum of the carina, which is flatter in the first, and with more pronounced borders and, also by more narrow laterals. Furthermore, the carino-latera of *T. darwinii* is usually wider than high, and both plates usually have a much narrower area of contact or are totally separated and there is a chitinous space around the apex of the inframedian latus, and occasionally at the upper portion of the carino-latus.

The problem of not considering *T. regium ovale* as a valid species, and the mixture of drawings of *T. regium* and *T. ovale* in the descriptions probably resulted in the misidentifications that appear in later studies, especially those of ZEVINA (1970; 1973; 1981b) and FOSTER & BUCKERIDGE (1995b). Consequently, it is difficult to determine the geographic distribution patterns of these species. Herein, I infer that *T. regium* and *T. ovale* are from the Atlantic Ocean and *T. gigas* and *T. darwinii* are from the Pacific ocean (Fig.22).

T. regium was recorded from the northern Pacific Ocean (ZEVINA, 1970; 1973), Australasian region (ZEVINA, 1981b), and Indian Ocean (FOSTER & BUCKERIDGE, 1995b). The northern Pacific records may be actually *T. gigas* or *T. darwinii* and the last two citations may indeed refer to *T. mollucanum* (Hoek, 1883).

Trianguloscalpellum mollucanum, described from the southwest Pacific (Fig.22), was considered a junior synonym of *S. regium* by ZEVINA (1970). Nonetheless, based on the hypothesis that *S. regium* does not occur in the Pacific ocean, I have to consider this synonymy as unacceptable. Some characters of its carina justify the distinction of this species: "it has a distinct tectum, which is not quite flat but slightly convex; the sides of the carina are at angles greater than 90° with the tectum. The apex projects freely" (HOEK, 1883). Despite the quality of Hoek's figures (1883:pl.V., figs.3-4), I can distinguish this species by much lower lateral plates and, the length of the carino-latus is nearly equal to the inframedian latus and rostro-latus. The length of the carino-latus in *S. regium* is larger than of the inframedian latus. The drawing of FOSTER & BUCKERIDGE (1995b:fig.6K) of a specimen from La Reunion, has a lower carino-latus and rostro-latus. Unfortunately, ZEVINA (1981b) did not describe or figure her specimens from the Australasian area.

Trianguloscalpellum darwinii (Hoek, 1883)
(Figs.20i-j, 22)

Scalpellum darwinii Hoek, 1883:110, tex-fig.3, pl.V, figs.1-2, pl.X, figs.3-5.

?*Scalpellum regium latidorsum* variety PILSBRY, 1907a:29, pl.II, figs.9-10.

Arcoscalpellum darwinii: NEWMAN & ROSS, 1971:58, text-fig.25, pl.IX E.

Scalpellum darwinii: ZEVINA, 1972:41, fig.1.

Trianguloscalpellum darwinii: ZEVINA, 1981a:301, fig.227.

Material – Eastern Pacific. Expedition Pulse IV, St. 426M, 34°44'N, 123°08'W, 4100m, 1 spec, SIO C9827; Pulse V, St. 505M, 34°43'N, 123°10'W, 4100m, 1 spec, SIO C9828; Pulse VI, St. 606M, 34°46'N, 123°06'W, 4100m, 2 spec, SIO C9829; Pulse XIX, St. 1906M, 34°41'N, 123°05'W, 4100m, 1 spec, SIO C9830; Pulse XIX, St. 1916M, 34°41'N, 123°11'W, 4100m, 1 spec, SIO C9831; Pulse XX, St. 2017M, 34°39'N, 122°58'W, 4100m, 5 spec, SIO C9832; Pulse XXI, St. 2108M, 34°44'N, 123°13'W, 4100m, 4 spec, SIO C9833; Pulse XXII, St. 2231M, 34°40'N, 123°11'W, 4100m, 1 spec, SIO C9834; Pulse XXIII, St. 2304M, 34°42'N, 123°14'W, 4100m, 1 spec, SIO C9835; Pulse XXIV, St. 2409M, 34°42'N, 123°05'W, 4100m, 4 spec, SIO C9836; Pulse XXIV, St. 2404M, 34°42'N, 123°09'W, 4100m, 3 spec, SIO C9837; Pulse XXV, St. 2534M, 34°40'N, 123°03'W, 4100m, 2 spec, SIO C9838.

Diagnosis – see NEWMAN & ROSS, 1971:58

Description – Capitulum (Figs.20i, j) with fourteen plates, swollen. Cuticle thick, pilose and with little protuberances. Carinal margin more convex than occludent. Small chitinous spaces usually present between carina and tergum and around apex of inframedian latus, occasionally along upper portion of carino-latus.

Scutum (Fig.20i) broad, length almost 1.5 times width; surface convex, ornamented with an apicobasal ridge. Occludent, scutal, and basal margins almost straight; lateral margin straight. Umbo at apex.

Tergum (Fig.20i) with its surface area greater than that of scutum. Apex nearly straight. Occludent margin slightly convex, carinal and scutal margins similarly arched. Basal angle pointed.

Carina (Figs.20i-j), uniformly arched, apex extending to more than 2/3 tergum length. Tectum convex, having lateral margin with low and thin longitudinal ribs, well developed laterals; an obtuse angle separates tectum from laterals. Basal margin V-shaped.

Upper-latus (Fig.20i) essentially triangular; basal margin convex, tergal and scutal straight.

Rostrum covered by rostro-latera, visible as a long, lengthened, rounded area between rostro-latera; apical umbo.

Rostro-latus (Fig.20i) trapeziform, scutal and basal margins parallel, scutal margin 1.5 to 2 times length of basal margin; with a conspicuous apico-basal ridge.

Inframedian latus (Fig.20i) triangular, equilateral or higher than wide, umbo apical, not projecting over scutum.

Carino-latus (Figs.20i-j) as high as wide or slightly wider. Umbo apical, slightly curved, with one conspicuous apico-basal ridge. Both plates meeting under carina in a narrow line or separated. Line of juncture usually 1/4 length of carino-latus.

Peduncle (Fig.20i) usually with same length as capitulum, sometimes longer, covered with laterally elongated scales, deeply imbedded in a thick cuticle.

The specimens ranged from 22 to 111mm in total length (capitulum length 12 to 53mm).

Remarks – This species was previously recorded from the Southeastern Pacific (NEWMAN & ROSS, 1971; ZEVINA, 1972) and herein its northern distribution is extended to off California. The specimens I studied were collected along the Californian coast by the Scripps Institution of Oceanography.

PILSBRY (1907a) recorded a variety of *Scalpellum regium* from the Pacific (Albatross, St. 3342, 52°39'30"N, 132°38'W, 1588 fathoms (2903m) which actually may be *T. darwinii*. His description agrees with the specimens I have examined except that the tectum of the carina is flat. Otherwise, the larger chitinous extensions observed around the apex of the inframedian latus and also at the upper portion of the carino-latus as he noted, was observed herein in some specimens.

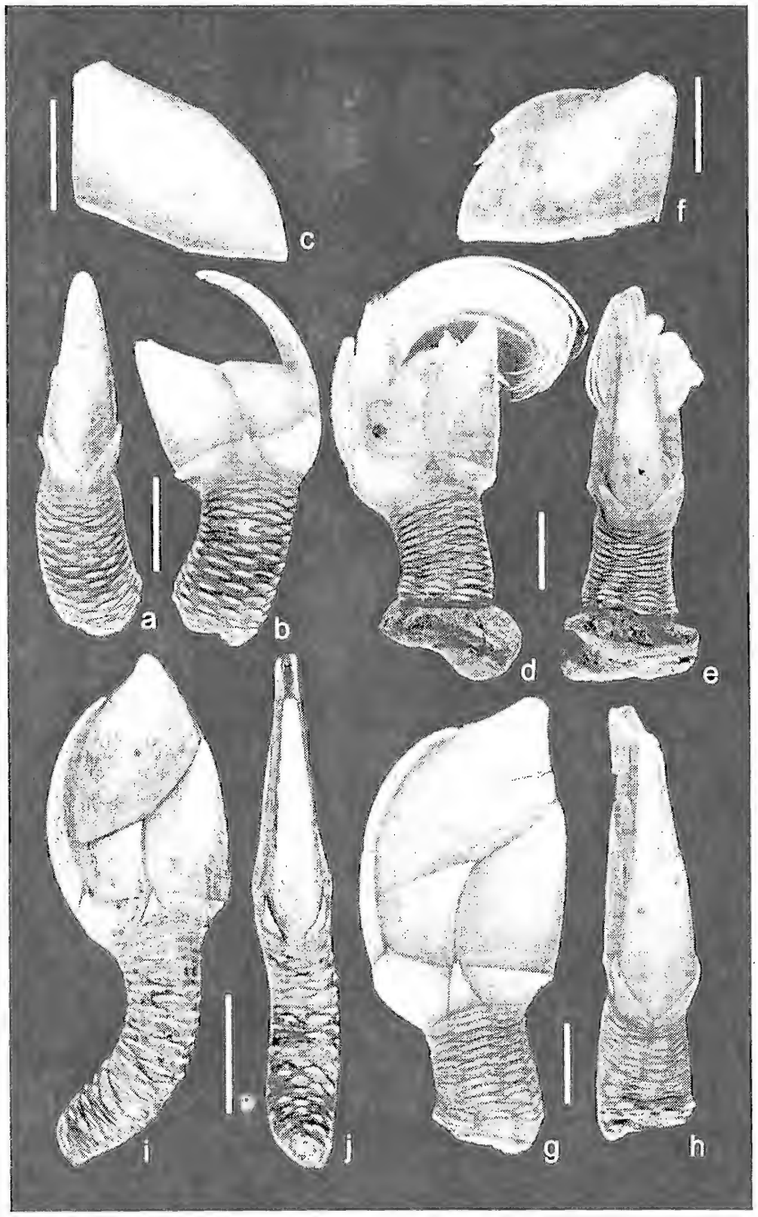

Fig.20- *Trianguloscalpellum regium* (Thomson), Types: a-b) carinal and lateral views of specimen from Challenger (St. 61), c) tergum of the same specimen, d-e) lateral and carinal views of another specimen from Challenger (St. 61) (Meteor St. 3-29), f) tergum and apical portion of carina of the same specimen, g-h) lateral and carinal views. *T. darwinii* (Hock): i-j) lateral and carinal views (Pulse 2409M). Bar: 10mm.

Trianguloscalpellum ovale (Hoek, 1883)

(Figs.21a-d, g, 22)

Scalpellum regium Wyville-Thomson, 1873: in part, only figs.1-2.

Scalpellum regium: WYVILLE-THOMSON, 1877: in part, only figs.2-3; PILSBRY, 1907a: in part, only pl.III, fig.4.

Scalpellum regium ovale Hoek, 1883:109, pl.V, figs.5-6.

Trianguloscalpellum regium ovale: ZEVINA, 1981a:311, fig.235.

Scalpellum gigas: GRUVEL, 1902a:52 and 126, pl.II, fig.3A, pl.III, figs.22-26 (not *Scalpellum gigas* HOEK, 1883).

Trianguloscalpellum gigas: FOSTER & BUCKERIDGE, 1995a:169, fig.2E (not *Scalpellum gigas* HOEK, 1883).

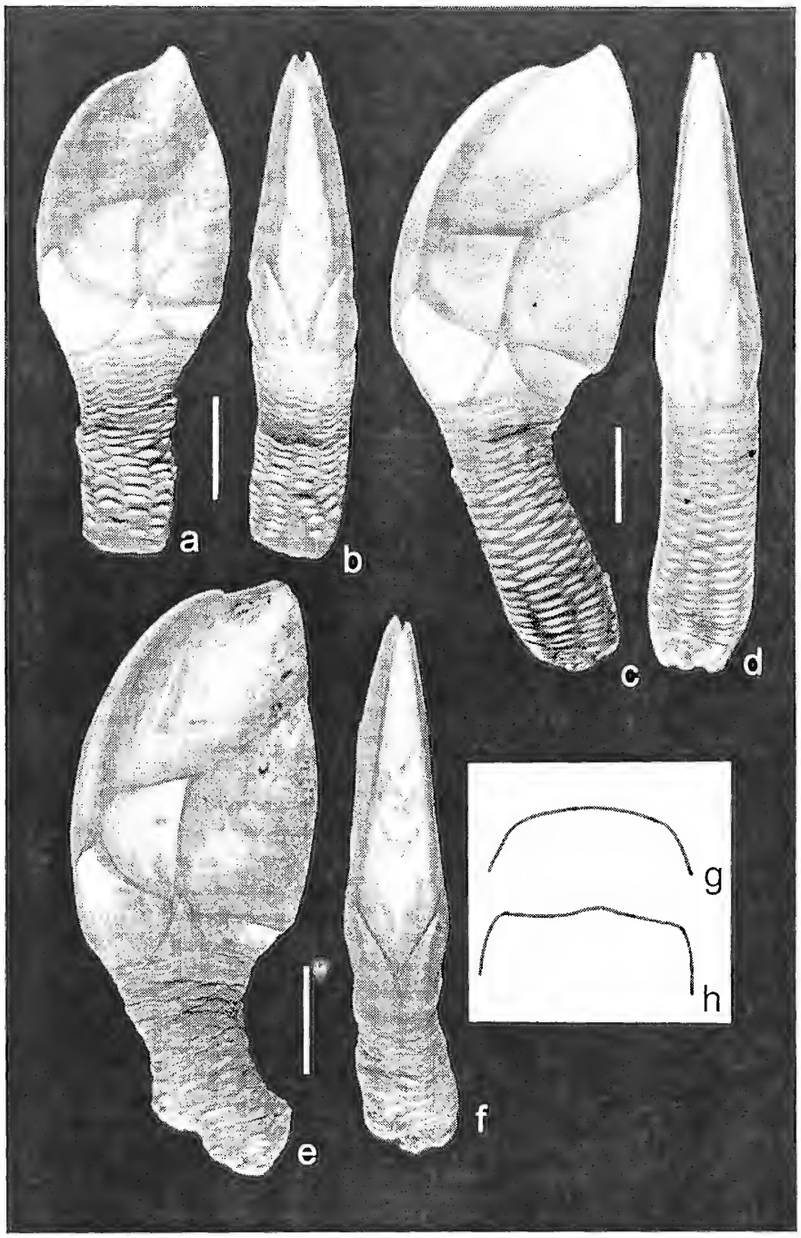

Fig.21- *Trianguloscalpellum ovale* (Hoek), Type: a-b) lateral and carinal views of specimen from Challenger St. 61, c-d) lateral and carinal views ("Meteor". st. 3-24). *T. gigas* (Hoek), Type: e-f) lateral and carinal views of specimen from Challenger St. 246. g-h) cross section of carina of *T. ovale* and *T. gigas*, respectively. Bar: 10mm.

Material – Eastern Atlantic. 45°48.6'N, 17°15.8'W, 4740m, 1 spec, SM; 45°49.8'N, 17°14. 2'W, 4730m, 1 spec, SM; 42°55.4'N, 14°07.9'W, 5260m, 6 spec, SM; 42°44.5'N, 13°29.8'W to 42°36.5'N, 13°34.3'W, 5315m, 8 spec, SM; 42°38.5'N, 13°31.0'W, 5318m, 3 spec, SM; 42°17.2'N, 14°46.3'W, 5270m 46 spec, SM; 42°04.1'N, 14°55.6'W, 5275m, 18 spec, SM: 21°0.7N - 21°8.5'N to 20°58'W-20°55.2'W, 4050-4140m (estimated), 6 spec, CAS, unnumbered.

Type – "Challenger" sta. 61, 34°54'N, 56°38'W, 2850 fathoms (5211m), 2 spec, BM, unnumbered.

Diagnosis – Carina simply bowed, with tectum convex and having small laterals. Umbo of carina at apex. Carino-latus higher than wide, both plates meeting broadly under carina. Upper-latus triangular. Peduncle greater than 3/4 of capitulum length.

Description – Capitulum (Figs.21a-d) with fourteen plates, slightly swollen laterally. Cuticle thin, with small protuberances. Carinal margin more convex than occludent. Spaces between plates filled by thick cuticle, which is greater between carina and tergum.

Scutum (Figs.21a, c) broad, length almost twice its width, surface convex. Occludent and lateral margins convex, scutal margin concave, and basal margin straight. Umbo at apex, projecting over tergum.

Tergum (Figs.21a, c) large, with same or larger surface area than scutum. Apex slightly reflexed. Occludent margin straight, carinal and scutal margins similarly curved. Basal angle pointed.

Carina (Figs.21a-d, g) regularly arched, apex reaching more than 2/3 length of tergum. Tectum convex, with small laterals formed continuously from tectum. Basal margin V-shaped.

Upper-latus (Figs.21a, c) essentially triangular; basal margin convex, tergal straight, and scutal concave.

Rostrum covered by rostro-latera, visible as a long, lengthened, rounded area between rostro-latera; umbo apical.

Rostro-latus (Fig.21a) trapeziform, scutal and basal margins parallel, former twice length of latter; with a conspicuous apico-basal ridge.

Inframedian latus (Figs.21a, c) triangular, equilateral with apical umbo, projecting over scutum.

Carino-latus (Figs.21a-d) higher than wide, its length about 1.5 times its width. Umbo apical, slightly curved. Both plates meeting under carina in a broad line. Length of juncture line 3/7 of carino-latus length.

Peduncle length greater than 3/4 of capitulum length, with laterally elongated scales, slightly imbedded in a thick cuticle.

The specimens varied from 7 to 70mm in overall length (capitulum length 4 to 42mm).

Remarks – The description presented here was based on the type specimens. Specimens from West Africa have the tectum of the carina flatter, and the carino-latus has a conspicuous apico-basal ridge.

Trianguloscalpellum gigas (Hoek, 1883)
(Figs.21e-f, h, 22)

Scalpellum gigas Hoek, 1883:102, pl.IV, figs.1-2, pl.IX, figs.11.

Scalpellum gigas: HOEK, 1884:4.

Arcoscalpellum gigas: NEWMAN & ROSS, 1971:60.

Trianguloscalpellum gigas: ZEVINA, 1978:1349; 1981a:317, fig.241.

not *Scalpellum gigas*: GRUVEL, 1902a:52, 126, pl.II, fig.3a, pl.III, figs.22-26 [= *Trianguloscalpellum ovale* (HOEK, 1883)]; FOSTER & BUCKERIDGE, 1995a:169, fig.2E [= *Trianguloscalpellum ovale* (HOEK, 1883)].

Material – Type. 'Challenger' St. 246, 36°10'N, 178°0'E, 2050 fathoms (3748m), 2 spec, BM, unnumbered.

Emended diagnosis – Capitulum with 14 valves. Carina simply arched, rather massive, with umbo at apex, slightly convex or flat tectum and two flat sides forming a slighltly obtuse, conspicuous angle with tectum. Upper-latus quadrangular. Carino-latus high, meeting broadly under carina. Peduncle longer than 1/2 length of capitulum.

Description – Capitulum (Figs.21e-f) with 14 plates, flat. Cuticle thin, with small protuberances. Carinal margin more convex than occludent. Spaces between plates filled by thick cuticle, the spaces greater between carina and tergum.

Scutum (Fig.21e) broad, length 1.5 width, surface little convex. Occludent margin slightly convex, other margins almost straight. Angle between basal and lateral margins truncated. Umbo apical, not projecting over tergum.

Tergum (Fig.21e) large, occupying same surface area as scutum. Apex straight. Occludent margin slightly convex, carinal and scutal margins similarly arched. Basal angle pointed.

Carina (Figs.21e-f, h) regularly arched, apex extending 2/3 length of tergum. Tectum nearly flat, with small laterals, separated by a right angle. Basal margin V-shaped.

Upper-latus (Fig.21e) essentially quadrangular, carinal margin, smaller, straight; basal margin convex, tergal and scutal margins essentially straight.

Rostrum covered by rostral laterals, visible at upper half as a long line on small specimens or conspicuous, and triangular on large specimens; umbo apical.

Rostro-latus (Fig.21e) trapeziform, scutal and basal margins parallel, former twice length of latter.

Inframedian latus (Fig.21e) triangular, equilateral, umbo apical.

Carino-latus (Figs.21e-f) higher than wide, length nearly 1. 4 times its width. Umbo at apex, slightly curved and projecting slightly laterally. Both plates meeting under carina in a broad line. Length of line of juncture 3/7 length of carino-latus.

Peduncle (Fig.21e) more than 1/2 length of capitulum, with laterally elongated scales deeply imbedded in a thick cuticle.

Order Sessilia Lamarck, 1818
Suborder Verrucomorpha Pilsbry, 1916
Family Verrucidae Darwin, 1854

Remarks -- PILSBRY (1916) defined four sections in the verrucids, *i.e.*: *Metaverruca*, *Verruca*, *Cameraverruca*, and *Altiverruca*. All of these were recognized as subgenera and many subsequent authors have elevated them to generic status (BROCH, 1931; ZEVINA, 1987a; BUCKERIDGE, 1994). The diagnoses used by PILSBRY (1916) for the sections were used as the generic diagnosis by ZEVINA (1987a) and BUCKERIDGE (1994).

The genus *Metaverruca* was defined as: (1) "The basal borders of the wall plates are inflected, forming a wide basal ridge, (2) the fixed-scutum bears a depending tongue-shaped adductor ridge or myophore, (3) the apex of the rostrum is marginal, (4) top (of shell is) flattened, (5) sculpture weak". From these characters the first two are considered diagnostic for the genus, the last three, marginal rostrum apex, shell flat, and weak sculpture (3-5) are characters of little taxonomic value for a generic classification. They occur in several species of *Verruca s.l.* Further, the presence of inflected basal borders of the wall plates, is not significant because the species have this inflection only when they reach full growth. Specimens without an inflected basal border may attain it at a latter stage. Finally, the myophore, which appeared to be a good diagnostic character, is well developed in *Verruca stroemia* (Müller), the type species of the genus *Verruca*. Even PILSBRY

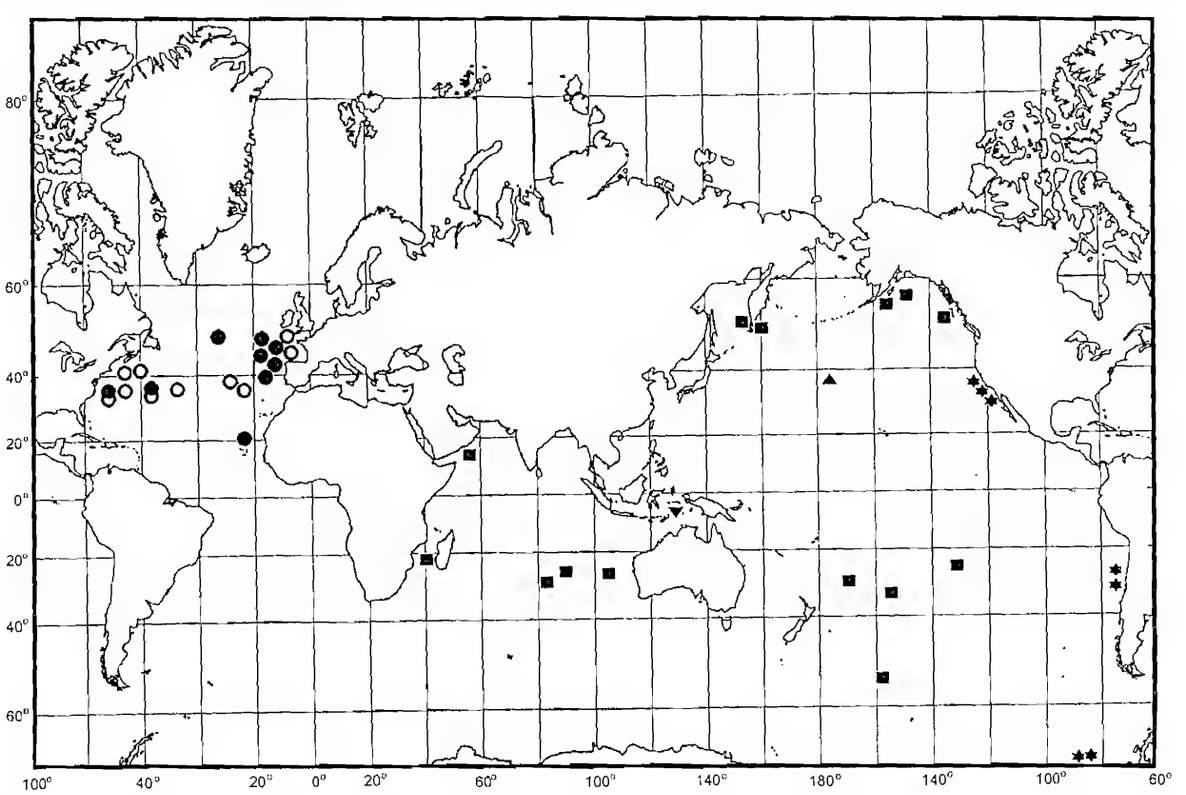

Fig.22- Geographic distribution: (○) *Trianguloscalpellum regium* (Thomson) – (■ questionable records), (✱) *T. darwinii* (Hoek), (●) *T. ovale* (Hoek). Type locality: (▲) *T. gigas* (Hoek); (▼) *T. moluccanum* (Hoek).

(1916:24), in his description of *Verruca stroemia*, wrote "Inside there is a very large adductor ridge or myophore". Therefore, based on the generally accepted diagnosis of *Metaverruca*, it is difficult to determine with certainty the distinction between *Metaverruca* and *Verruca s.s.*

All the species discussed herein are from *Metaverruca*, except *V. stroemia*.

Genus *Verruca* Schumacher, 1817
Verruca stroemia (Müller, 1776)

Lepas strömia Müller, 1776:251.

Verruca strömia: DARWIN, 1854:518, pl.21, fig.1a-f.; PILSBRY, 1916:24.

Material – Eastern Atlantic. 36°43'N, 11°45'W, 118m, 42 spec, SM.

Remarks – The specimens were attached to two small rounded rocks. All of them were depressed with small opercular valves. The shell usually had a rostrum larger than the other plates and many thin sculptured growth lines. Internally, as PILSBRY (1916) noted, there is a well developed myophore.

V. stroemia is a shallow-water species found commonly along the coast of Europe, from Norway to Portugal, and also from Iceland, Greenland and the Mediterranean. This new record is one of the most southern. GRUVEL (1902a; 1920) recorded this species as far south as the Azores, but the depth recorded (960-998 and 2600m) is unusual, because it normally ranges from 0 to 548m, but most commonly between 20 to 300m (NILSSON-CANTELL, 1978).

The specimens ranged from 3 to 5mm in carino-rostral length.

Genus *Metaverruca* Pilsbry, 1916
Metaverruca recta (Aurivillius, 1898)
(Figs.23a-e, 24a-j, 25)

Verruca recta Aurivillius, 1898:195.

Verruca sculpta Aurivillius, 1898:197.

Verruca linearis Gruvel, 1900b:243.

Verruca magna Gruvel, 1901:261.

Verruca linearis: GRUVEL, 1902a:107, pl.V, figs.11-12; 1905:182, fig.201; HOEK, 1907b:9.

Verruca magna: GRUVEL, 1902a:109, pl.V, figs.1-2; 1905:*184*, figs.204-205; HOEK, 1907b: 9; GRUVEL, 1920:50; WEISBORD, 1979:98.

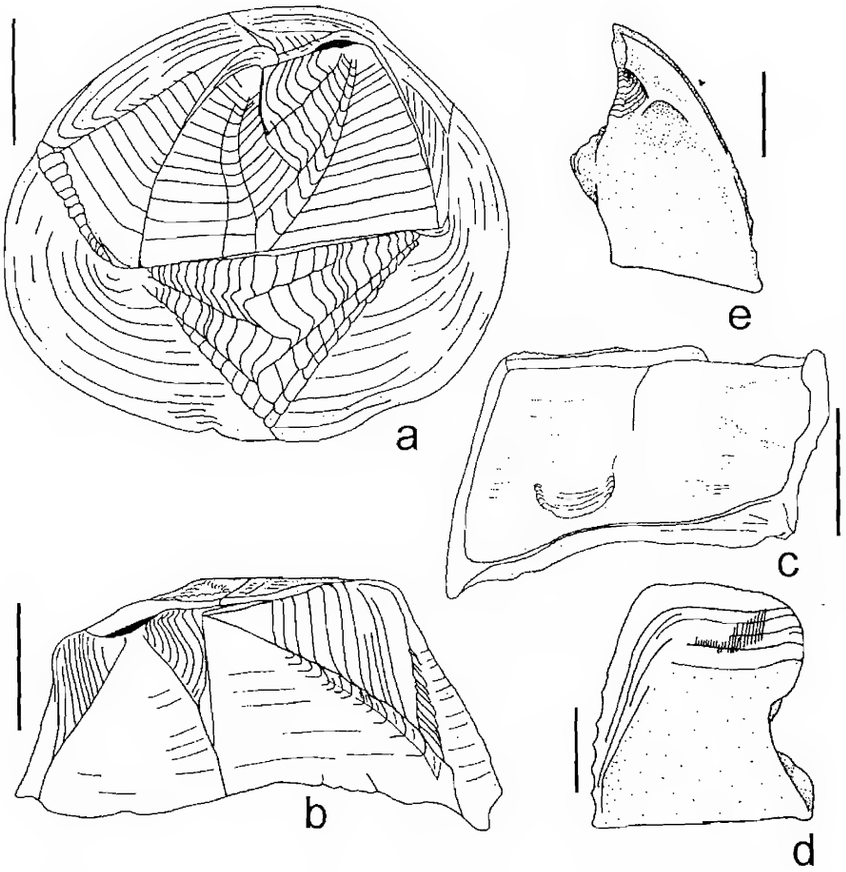

Fig.23- *Metaverruca recta* Aurivillius: a) top view, b) fixed-tergum and fixed-scutum view, c) fixed-scutum and fixed-tergum, internal view, d-e) tergum and scutum, internal view. Bar: a-c) 2mm; d-e) 1mm.

Verruca recta: GRUVEL, 1905:181; HOEK, 1907b:9; GRUVEL, 1912a:6; 1920:46, pl.II, fig.18, pl.III, figs.3-4; SOUTHWARD & SOUTHWARD, 1958:637, fig.4; ANDERSON, 1980:349, figs.1-4.

Verruca sculpta: GRUVEL, 1905:175; HOEK, 1907b:9; GRUVEL, 1920:41, pl.V, figs.26-27; NILSSON-CANTELL, 1929:461, fig.1; 1938a:12; KRÜGER, 1940:463; ZEVINA, 1969:68; WEISBORD, 1979:97; FOSTER, 1981:352; REN, 1984:166, fig.1, pl.I, figs.1-6; 1989:420, fig.10.

Verruca capsula Hoek, 1913:130, pl.XII, figs.1-3, pl.XIII, figs.1-4.

Verruca halotheca Pilsbry, 1907b:188, pl.IV, figs.9-10.

Verruca coraliophila Pilsbry, 1916:21, pl.1, figs.1-5.

Verruca halotheca: PILSBRY, 1916:46, pl.8, figs.1-1a; KOLOSVÁRY, 1943:73; ZULLO, 1968:219; GORDON, 1970:118; BUCKERIDGE, 1975:129, figs.5. 4-6; FOSTER, 1978:69, pl.8F, fig.42; WEISBORD, 1979:98.

Verruca (Metaverruca) sculpta: BROCH, 1931:41; BUCKERIDGE, 1983:59, fig.45.

Verruca capsula: STUBBINGS, 1936:38; WEISBORD, 1979:98.

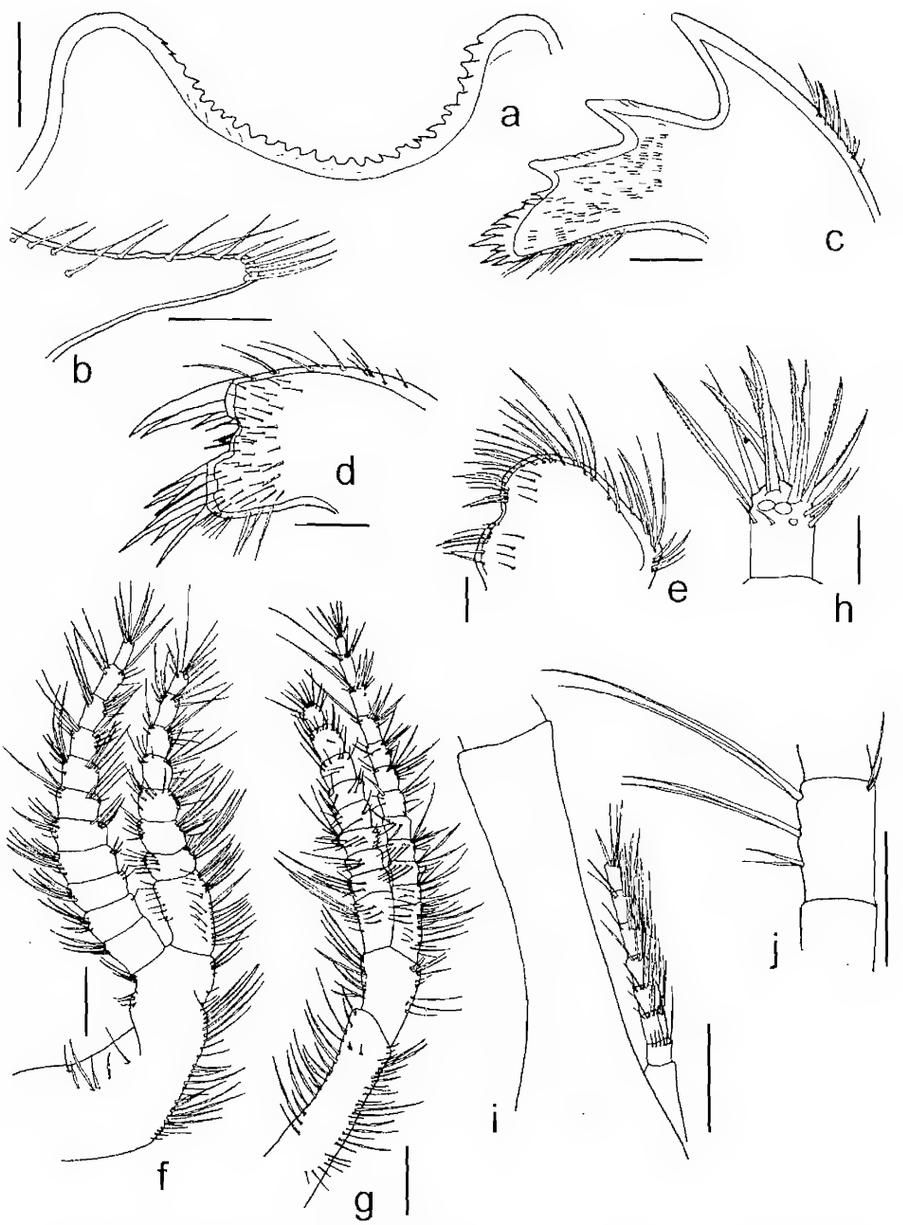

Fig.24- *Metaverruca recta* Aurivillius: a) labrum, b) palp, c) mandible, d) maxilla I, e) maxilla II, f) cirrus I, g) cirrus II, h) distal article of anterior ramus of cirrus II, i) coxopodite and median article of cirrus VI, j) caudal appendage. Bar: a-e, h) 0.1mm; f-g, i-j) 0.3mm.

Verruca coraliophila: ZULLO, 1968:219; BAYER, VOSS & ROBINS, 1970:A43; WEISBORD, 1979:96.

Verruca (Metaverruca) cookei: ROSELL, 1981:299, pl.XI, figs.r, s, u, v; 1991:33 (not *Verruca cookei Pilsbry*, 1927).

Metaverruca recta: BUCKERIDGE, 1994:116, fig.13a-f; FOSTER & BUCKERIDGE, 1995a:182, fig.15; 1995b:368, fig.9C-E.

Material – Eastern Atlantic. 37°39.0'N, 09°32.0'W, 1430-1370m, 1 spec, SM; 36°46.2'N, 14°14.5'W, 657m, 1 shell, 33°34.2'N, 09°19.3'W, 1300m, 7 spec, SM; 33°12.6'N, 09°15.2'W, 500m, 8 spec and 1 shell, SM; 30°08'N, 28°38.5'W, 269m, 7 shells, SM; 29°58.5'N, 28°35.0'W, 403-348m, 4 shells, SM; 29°58.5'N, 28°39.2'W, 343-335m, 1 spec and 3 shells, SM; 29°49.5'N, 28°19.5'W, 311-322m, 2 shells, SM; 30°03.0'N, 28°40.0'W, 450-505m, 1 spec and 2 shells, SM.

Diagnosis – Shell smooth; three articular ridges on scutum and tergum; cirrus I with subequal rami; cirrus II with an anterior ramus 3/4 length of posterior ramus, anterior ramus with stout bipectinate setae; caudal appendage multiarticulated, 2/3 length of coxopodite of cirrus VI.

Description – Shell white, low, smooth, and little ornamented (Figs.23a,b). Opercular plates parallel to basis. Basal margin of wall inflected. Fixed tergum and scutum fused in older specimens. Aperture straight at the basal margin of opercular plates.

Fixed-tergum (Fig.23b) slightly smaller than fixed-scutum, with marginal apex slightly recurved outward; with two developed alate projections.

Fixed-scutum triangular (Fig.23b), with a well developed alate projection at rostral suture and a small radius-like projection at fixed-tergal suture; apex marginal. Internally, with a well developed myophore directed basally (Fig.23c).

Carina (Fig.23a) as large as rostrum, with a well developed low ridged area at suture with rostrum, forming up to four interlocking teeth, first or second larger than others; smooth suture with fixed-tergum.

Rostrum (Fig.23a) with a flat, denticulated radius directed toward fixed-scutum, and a well developed, low, ridged area at suture with carina, with three or four interlocking teeth.

Tergum (Figs.23a,d) larger than scutum, nearly quadrangular, with three articular ridges, the third at basi-scutal angle higher, but narrower than

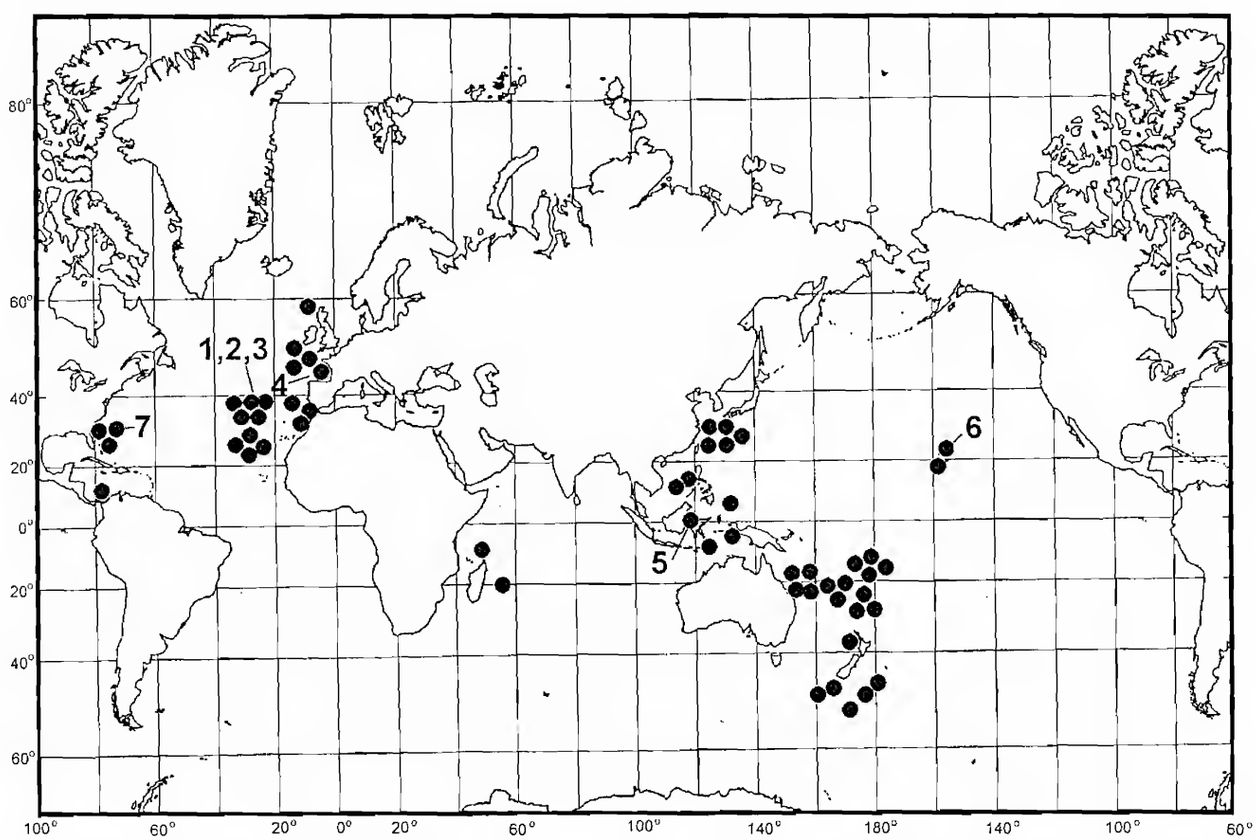

Fig.25- Geographic distribution: (●) *Metaverruca recta* Aurivillius. The numbers show the type localities of (1) *V. recta* and its synonyms: (2) *V. sculpta* Aurivillius, (3) *V. linearis* Gruvel, (4) *V. magna* Gruvel, (5) *V. capsula* Hoek, (6) *V. halotheca* Pilsbry and, (7) *V. coraliophila* Pilsbry.

others; no ridges at the carinal area. Internally, surface flat and smooth, except with a thickening at the upper and carinal areas, forming some curved lines; scutal margin with a deep concavity.

Scutum (Fig.23a, e) with three articular ridges, the first and third small, the second large, no ridges at rostral area. Internally, occludent margin with a prominent tooth formed by second articular ridge, a deep groove at upper margin; surface flat, but with a conspicuous pit for adductor muscle; no vestige of an articular ridge.

Labrum (Fig.24a) with one row of 27 simple, sharp teeth. Palp (Fig.24b) small, acuminate, with simple setae at upper margin. Mandible (Fig.24c) with three sharp teeth, tooth two and three with subsidiary cusps at upper margin, and denticulated lower angle. Maxilla I (Fig.24d) with a conspicuous shallow notch; lower anterior border projecting anteriorly; upper border with two large and one or two small spines, followed by four small spines at notch and six to seven median spines at lower border. Maxilla II (Fig.24e) triangular, anterior margin with a small concavity medially; and numerous simple setae along its margins.

Cirrus I (Fig.24f) with subequal rami, both rami with slightly protuberant articles covered by numerous simple setae. Cirri II (Fig.24g) with unequal rami, anterior ramus about 3/4 length of posterior. Anterior ramus with stout, bipectinate setae at the three distal articles (Fig.24h), and numerous large, simple setae on all articles. Posterior ramus with few simple setae. Cirri III to VI with essentially equal rami; median articles (Fig.24i) with three pairs of setae on anterior margin and one or two setae on posterior angle, length about twice width.

Caudal appendage (Fig.24j) multiarticulated, short, 2/3 length of coxopodite of cirrus VI; articles covered by numerous simple setae at its distal margins.

Number of articles of cirri and caudal appendage is presented in table 3.

The specimens ranged from 3 to 8mm in carino-rostral length.

TABLE 3

NUMBER OF ARTICLES OF CIRRI, AND CAUDAL APPENDAGES OF *METAVERRUCA RECTA*

	CI	CII	CIII	CIV	CV	CVI	CA
RC	8/11	9/12	17/20	23/28	26/30	29/30	7
LC	9/10	8/12	16/19	23/27	28/29	29/31	10

(CI-VI) cirri I to VI; (CA) caudal appendage; (RC) right cirri; (LC) LEFT CIRRI.

Remarks – *Metaverruca recta* was described from the Azores (AURIVILLIUS, 1898) as were *V. sculpta* Aurivillius, 1898, *V. linearis* Gruvel, 1900, *V. magna* Gruvel, 1901, all of which are included in its synonymy (GRUVEL, 1920; NILSSON-CANTELL, 1929; 1938a; SOUTHWARD & SOUTHWARD, 1958; BUCKERIDGE, 1994; FOSTER & BUCKERIDGE, 1995a). Further, *V. capsula* Hoek, 1883, described from the Indo-Malasian region, *V. halotheca* Pilsbry, 1907, from Hawaii, and *V. coraliophila* Pilsbry, 1916, from off Florida were also considered synonymous with this species (NILSSON-CANTELL, 1929; 1938a; BUCKERIDGE, 1994; FOSTER & BUCKERIDGE, 1995a) (Fig.25). All of these species have a large myophore and they were considered the same species.

Recently, the verrucids described by BROCH (1931), ZEVINA (1987b), BUCKERIDGE (1994) and FOSTER & BUCKERIDGE (1995b) showed a great diversity of species in Metaverruca. BUCKERIDGE (1994), excluding *M. recta,* recorded four new species of *Metaverruca* from New Caledonia.

All of the species synonymous with *M. recta,* have a similar morphology: *e.g.* a smooth shell, three articular ribs on the scutum and tergum, and a myophore on the fixed-scutum. PILSBRY (1916) stated that the mouth parts and cirral chaetotaxy were so similar "that it is hardly necessary to figure cirri of numerous species". He only discussed the different proportions of the rami of cirri I-III and caudal appendages. Unfortunatelly, due to this generalization, the soft parts of verrucids are poorly known.

Most of the mouth parts and appendages of the species synonymous with *M. recta* have not been described (*V. sculpta*; *V. linearis*; *V. magna*; *V. halotheca*; *V. coraliophila*) and I infer that we may be grouping distinct species. The following new species, described from a sample, which also had *M. recta,* has a shell morphology similar to *M. recta,* but has dramatically different appendages. A detailed examination of the appendages of both species show many distinctions on the relative length of cirral rami and caudal appendages. Further, both species have distinct special cards (bipectinate setae) on the tip of the anterior ramus of cirri II, which has not been reported previously for verrucomorphs.

Figure 25 shows the general distribution of *M. recta s.l.* and also shows the type-locality for all the species included in its synonymy.

Metaverruca sensibilis n.sp.
(Figs.26a-e, 27a-h, 28)

Material examined – Eastern Atlantic. HOLOTYPE. Moroccan coast: St. 8-25, AT10, 30-31.01.67, 33°12,6'N, 09°15,2'W, 500m, SM. PARATYPES: same locality: 2 spec, SM, USNM 274310.

Diagnosis – Shell smooth; four articular ridges on scutum and tergum; fixed-scutum with a well developed myophore; cirrus I with anterior ramus 2/3 length of posterior ramus; cirrus II with anterior ramus 1/3 length of posterior ramus, anterior ramus with thin bipectinate setae; caudal appendage long, five times length of coxopodite of cirrus VI.

Description – Shell (Figs.26a, b) white, low, smooth, and poorly ornamented, only the ridges on the opercular plates and at suture of rostrum and carina conspicuous. Opercular plates parallel with basis. Basal margin of wall not inflected. Aperture nearly straight at the basal margin of opercular plates.

Fixed-tergum (Fig.26b) smaller than fixed-scutum, with a marginal apex greatly thickened, recurved outward; with two well developed ala-like projections and a triangular central area.

Fixed-scutum (Fig.26b) triangular, well developed, alate projection at rostral suture area, and a small radius-like projection at fixed-tergum side; a denticulated occludent ridge runs between parietal and alate projections; apex marginal and thickened. Internally, with a well developed myophore parallel to basis (Fig.26c).

Carina (Fig.26a) smaller than rostrum, with a well developed low ridge area at suture with rostrum, with five to eight interlocking teeth, the largest being usually the third; smooth suture with fixed-tergum.

Rostrum (Fig.26a) with a small radius-like projection at fixed-scutum side and a well developed low ridged area at suture with carina, with five to eight interlocking teeth, the second and third usually being the largest.

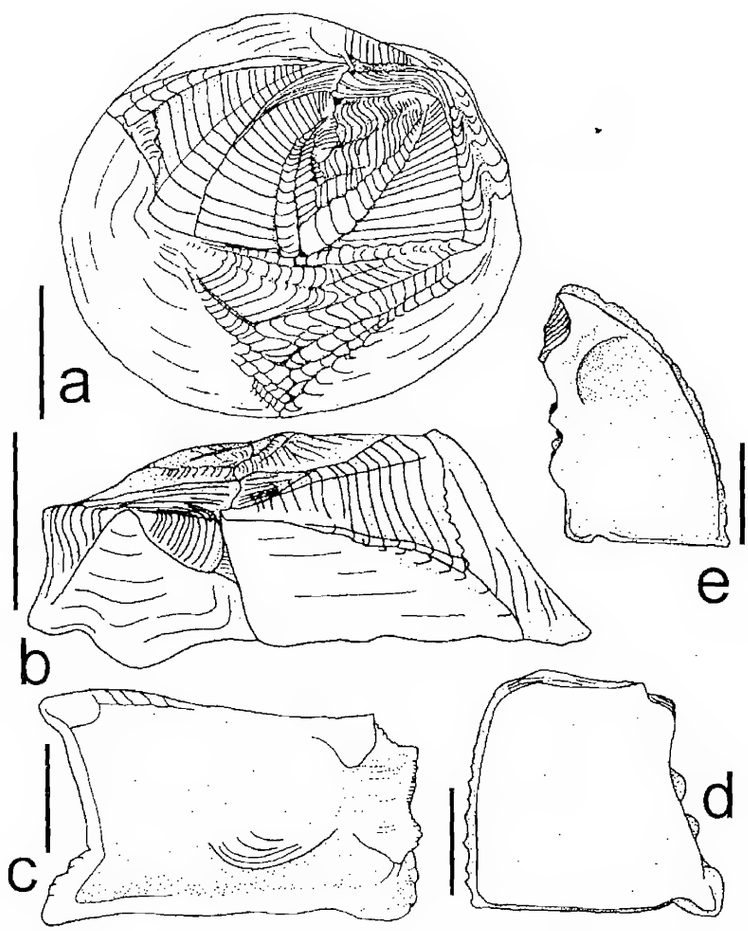

Fig.26- *Metaverruca sensibilis* n.sp., Holotype: a) top view, b) fixed-tergum and fixed-scutum view, c) fixed-scutum, internal view, d-e) tergum and scutum, internal view. Bar: a-b) 2mm; c-e) 1mm.

Tergum (Fig.26d) larger than scutum, nearly quadrangular, with four articular ridges; distance between first and second large; third ridge smallest and secondary; fourth at basi-scutal angle highest and largest; no ridges at the carinal area. Internally, surface totally flat and smooth; scutal margin slightly concave.

Scutum (Fig.26e) with four articular ridges, the second small and secondary, no ridges at rostral area. Internally, tergal margin sinuous with a shallow groove at upper margin; surface flat, except for the adductor muscle pit; no vestiges of articular ridge.

Labrum (Fig.27a) with one row of 16 small teeth. Palp (Fig.27a) small, acuminate, with few simple setae at its margins. Mandible (Fig.27b) with three sharp teeth, first larger than second and third, with a denticulated lower angle. Maxilla I (Fig.27c) with a conspicuous shallow medial notch; inferior anterior border projecting; superior border with two large and two small spines, followed by three small spines at notch and eight median spines at inferior border. Maxilla II (Fig.27d) triangular, anterior margin with small concavity medially; with numerous simple setae along its margins.

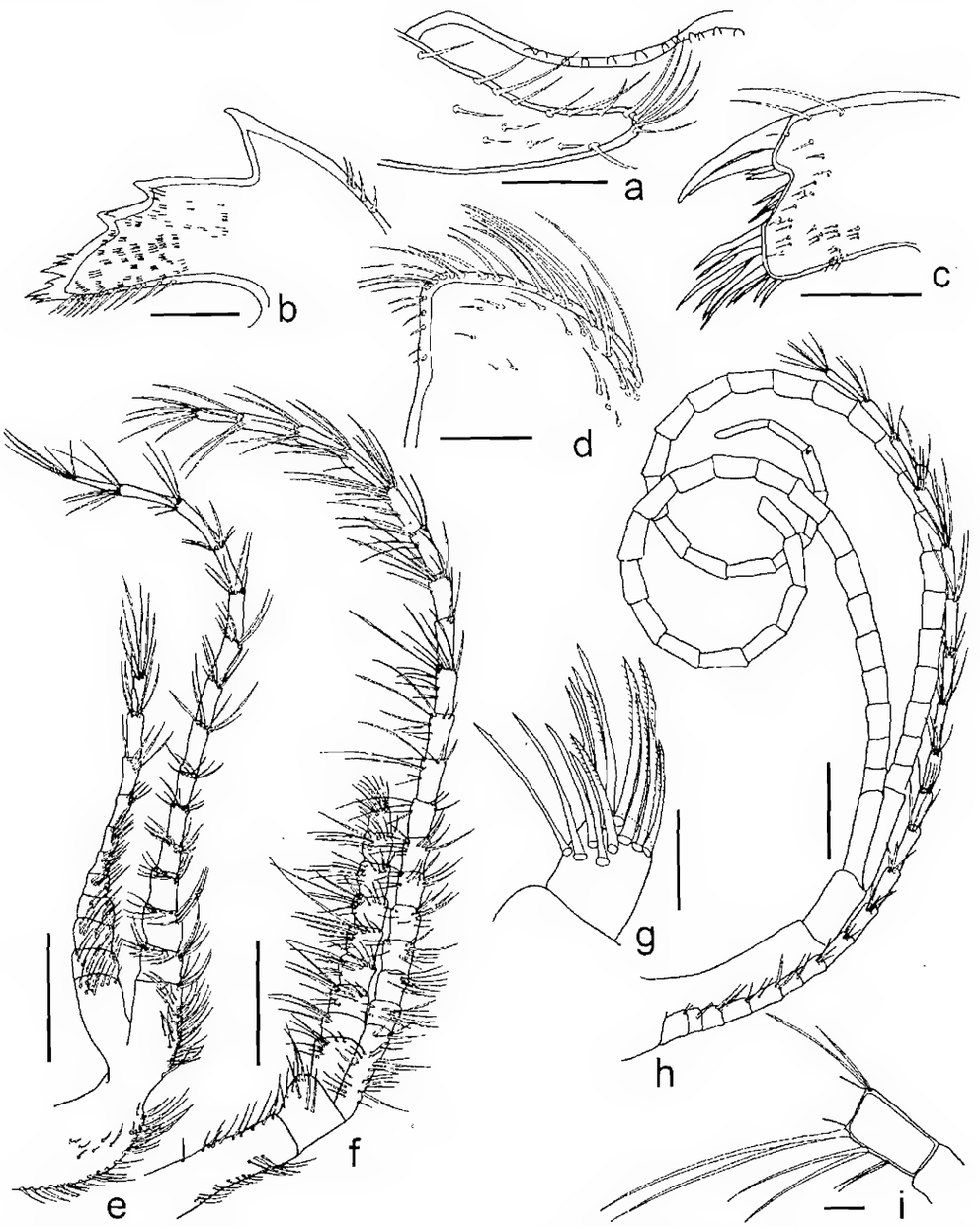

Fig.27- *Metaverruca sensibilis* n.sp.: a) labrum and palp, b) mandible, c) maxilla I, d) maxilla II, e) cirrus I, f) cirrus II, g) distal article of anterior ramus of cirrus II, h) cirrus VI and caudal appendage, i) median article of cirrus VI. Bar: a-d, g, i) 0.1mm; e-f, h) 0.5mm.

Cirrus I (Fig.27e) with unequal rami, anterior 2/3 of length of posterior. Anterior ramus with articles slightly protuberant, covered by numerous simple setae. Posterior ramus, antenniform; articles with few large simple setae at distal margins. Cirri II (Fig.27f) with unequal rami, anterior 1/3 length of posterior. Anterior ramus with thin, bipectinate setae at distal articles (Fig.27g), and numerous large and simple setae along all articles. Posterior ramus with large simple setae at distal margins of articles and small setae at anterior margins. Cirri III to VI with equal rami (Fig.27h); median articles of cirrus VI (Fig.27i) with 3 pairs of setae on anterior margin and 1-2 setae on the posterior angle, length of articles about twice width.

Caudal appendage (Fig.27h) multiarticulate, approximately 2/3 length of cirrus VI or 5 times length of coxopodite; articles covered by numerous simple setae at distal margins.

Number of articles of cirri and caudal appendage is presented in table 4.

The holotype is 7mm in carino-rostral length, the paratypes ranged from 5 to 6mm in carino-rostral length.

TABLE 4

NUMBER OF ARTICLES OF CIRRI AND CAUDAL APPENDAGES OF THE HOLOTYPE OF *METAVERRUCA SENSIBILIS* N.SP.

	CI	CII	CIII	CIV	CV	CVI	CA
RC	8/18	11/15	18/20	22/24	26/27	23+/27	20
LC	8/18	11/15	17/20	23/24	24+/27	28/27	+

(CI-VI) cirri I to VI; (CA) caudal appendage; (RC) right cirri; (LC) left cirri; (+) broken ramus.

Etymology – From the Latin, *sensibilis*, perceptible, in reference to the long caudal appendages, which probably are employed in perceiving the environment.

Remarks – BUCKERIDGE (1994) listed eight Recent species of *Metaverruca* and FOSTER & BUCKERIDGE (1995b) added one more species, *M. reunioni*.

M. sensibilis n.sp., from the same area as *M. recta*, can be distinguished by having: (1) four articular ribs in the scutum and tergum instead of three; (2) more than four articular ridges in each rostrum or carina instead of less than four; (3) cirrus I with unequal rami, anterior ramus 2/3 length of posterior ramus, instead of the anterior ramus with same length of posterior ramus; (4) cirrus II with a proportion of 1/3, instead of a proportion of 3/4 and, (5) a long caudal appendage, which is 5 times the length of coxopodite, instead of a caudal appendage which is 2/3 length of coxopodite of cirrus VI.

M. corrugata (Broch, 1931), *M. lepista* (Zevina, 1987) and *M. seriola* (Zevina, 1987) have three articular ridges on the scutum and tergum and, a caudal appendage as long as the coxopodite (BROCH, 1931; ZEVINA, 1987b). Despite their terse descriptions, I noted that *M. defayeae* Buckeridge, 1994 and *M. norfolkensis* Buckeridge, 1994 have caudal appendages smaller than the coxopodite and the last one has few articular ridges between rostrum and carina (BUCKERIDGE, 1994). *Metaverruca plicata* Buckeridge, 1994, has a shell with strong longitudinal ribs and three articular ribs between the tergum and scutum (BUCKERIDGE, 1994). *Metaverruca reunioni* Foster & Buckeridge, 1995, has smooth opercular valves, without an articular ridge and its caudal appendage is a little larger than the coxopodite (FOSTER & BUCKERIDGE, 1995b).

Metaverruca pacifica Buckeridge (1994) described from New Caledonia, Loyalty and Chesterfield Islands is similar to *M. sensibilis* n.sp., but this species has a caudal appendage only twice the length of the coxopodite; up to five articular ridges between rostrum and carina; and BUCKERIDGE (1994: fig.11a) portrays ridges from the rostrum directed toward the base of scutum, and in fig.11c-d shows four primary articular ribs on the scutum and tergum.

M. sensibilis n.sp. is known from only the Moroccan coast (Fig.28).

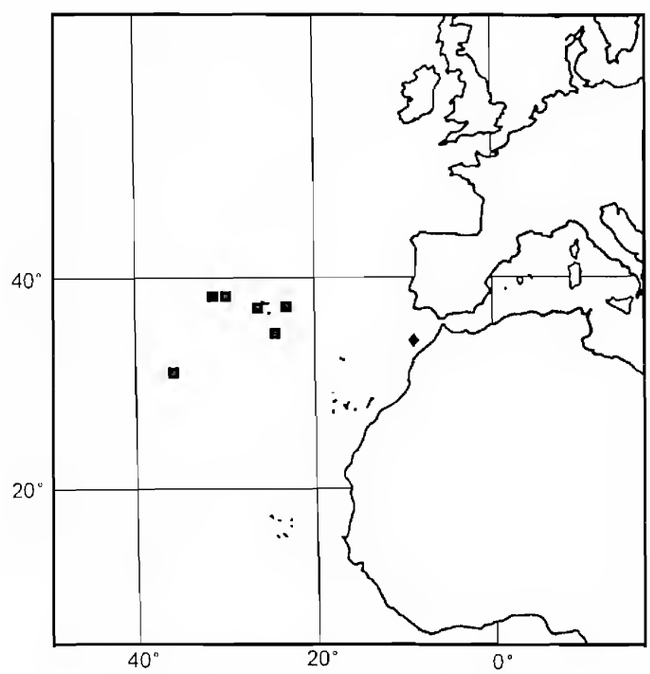

Fig.28- Geographic distribution: (◆) *Metaverruca sensibilis* n.sp., (■) *Metaverruca cornuta* Aurivillius.

Metaverruca cornuta (Aurivillius, 1898)
(Figs.28, 29a-e, 30a-h)

Verruca cornuta Aurivillius, 1898:197.
Verruca cornuta: GRUVEL, 1905:174; HOEK, 1907b:9; GRUVEL, 1912a:5; 1920:39, pl.II, figs.12-13; pl.III, figs.9-10.

Material – Eastern Atlantic. 30°03.0'N, 28°40.0'W, 450-505m, 1 spec, SM.

Diagnosis – Shell weakly ornamented with conspicuous ridges on rostrum directed toward base of scutum; three articular ridges on scutum and tergum; fixed-scutum with a well developed myophore; cirrus I with unequal rami; cirrus II with anterior ramus 3/4 length of posterior ramus, articles with simple setae; caudal appendage slightly longer than coxopodite of cirrus VI.

Description – Shell (Figs.29a, b) white, low, weakly ornamented, only the articular ridges on the opercular plates, at suture of rostrum and carina, and on rostrum directed toward base of scutum conspicuous. Opercular plates parallel with basis. Basal margin without an inflected ledge, but thickening at the basal margin.

Fixed-tergum (Fig.29b) smaller than fixed-scutum, with a marginal apex, recurved outward; with two alate projections and a triangular central area.

Fixed-scutum (Fig.29b) triangular, well developed alate projection in area of rostral suture, and a small radius-like projection at fixed-tergum side; a denticulated occludent ridge occurs between the parietes and alate projection; apex marginal and thickened. Internally, with a well developed myophore parallel to basis (Fig.29c).

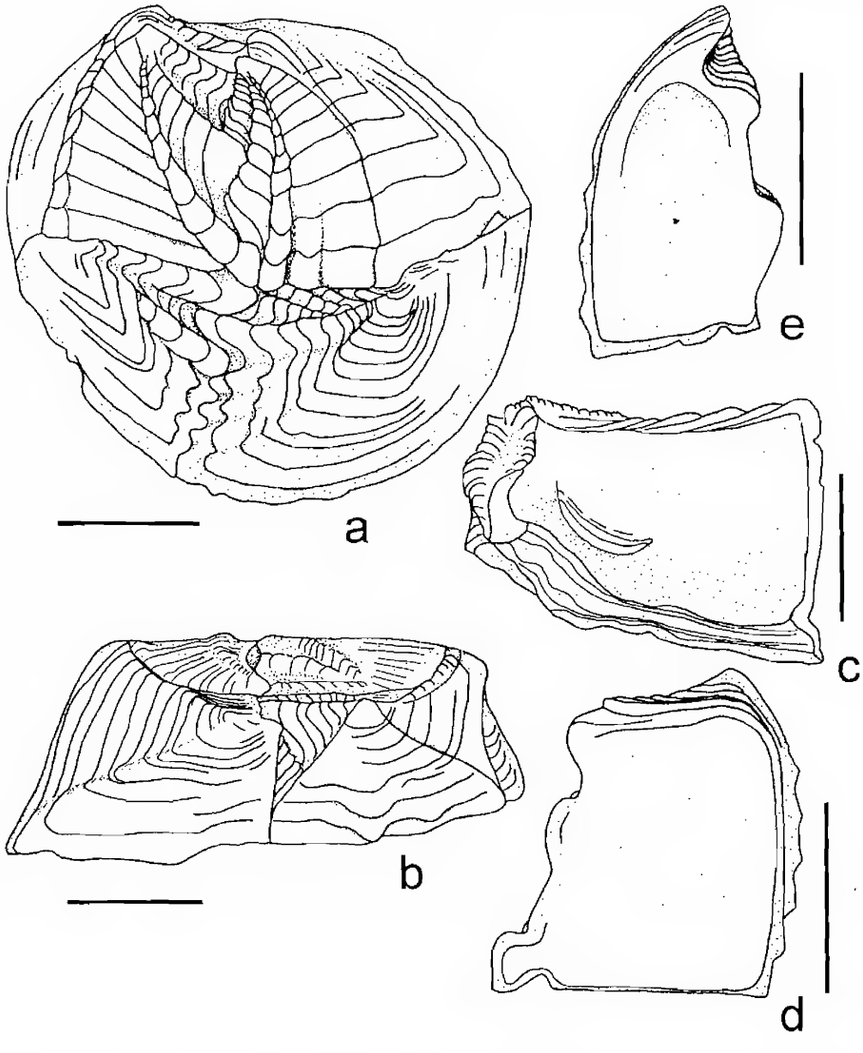

Fig.29- *Metaverruca cornuta* Aurivillius: a) top view, b) fixed-tergum and fixed-scutum view, c) fixed-scutum, internal view, d-e) tergum and scutum, internal view. Bar: 1mm.

Carina (Fig.29a) smaller than rostrum, with a well developed low ridge in area of rostral suture, with six interlocking teeth, decreasing in size towards basis and with a small radius directed toward tergum.

Rostrum (Fig.29a) with a small radius-like projection at fixed-scutum suture; a well developed, low, ridged area at suture with carina, five interlocking teeth, the first usually largest; three ribs turning toward base of scutum. Apex slightly displaced from marginal region.

Tergum (Fig.29d) larger than scutum, nearly quadrangular, with three articular ridges; all ridges approximately the same width, but third higher; no ridges at the carinal area. Internal surface flat and smooth; scutal margin slightly concave.

Scutum (Fig.29e) with three conspicuous articular ridges, the third narrower and with one incomplete ridge at rostral area near the third articular ridge. Internally, tergal margin sinuous with a shallow groove at upper margin; surface flat, except for adductor muscle pit; no vestige of articular ridge.

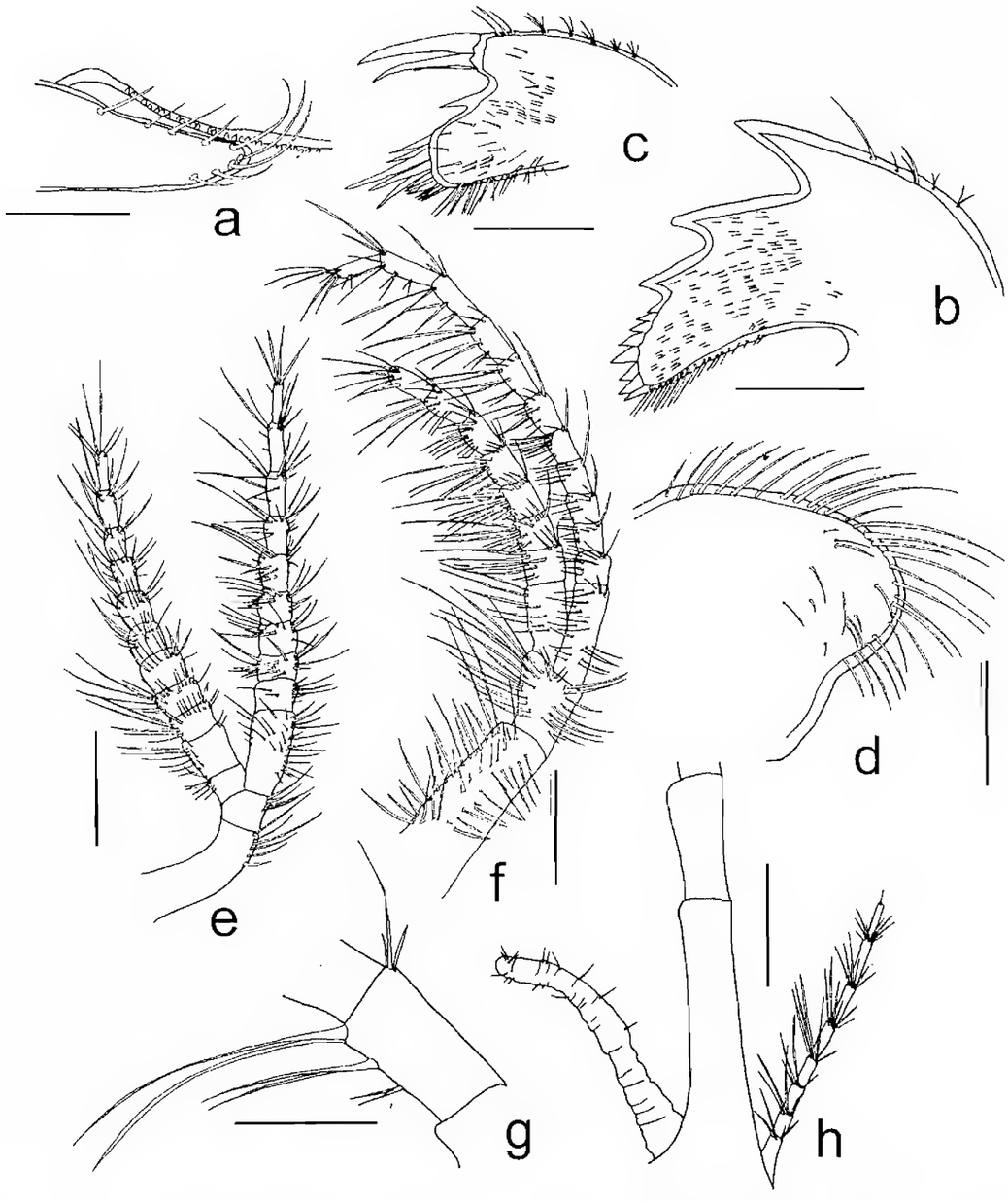

Fig.30- *Metaverruca cornuta* Aurivillius: a) labrum and palp, b) mandible, c) maxilla I, d) maxilla II, e) cirrus I, f) cirrus II, g) median article of cirrus VI, h) protopodite of cirrus VI, caudal appendage, and penis. Bar: a-d) 0.1mm; e-h) 0.3mm.

Labrum (Fig.30a) with one row of 27 small teeth. Palp (Fig.30a) small, acuminate, with few simple setae at margins. Mandible (Fig.30b) with three sharp teeth, second tooth may be bifid; third tooth may have subsidiary cusps, with a denticulated lower angle. Maxilla I (Fig.30c) with conspicuous supramedial notch; lower anterior border projecting anteriorly; upper border with two large spines, followed by one small spine at notch and nine medial and numerous inferior small spines.

Maxilla II (Fig.30d) rounded, with numerous simple setae along margin.

Cirrus I (Fig.30e) with unequal rami, anterior slightly smaller than posterior, and slightly protuberant articles; articles of both rami covered by numerous simple setae. Cirrus II (Fig.30f) with unequal rami, anterior 3/4 length of posterior; both rami with simple setae. Cirrus III with subequal rami and cirri IV to VI with equal rami; length of median articles of posterior cirri about twice the width (Fig.30g), with three pairs of setae on anterior margin and one or two setae on the posterior angle.

Caudal appendage (Fig.30h) multiarticulated, consisting of eight articles, slightly longer than coxopodite of cirrus VI; articles covered by numerous simple setae at distal margins.

Number of articles of cirri and caudal appendage is presented in table 5.

The single specimen studied was 4mm in carino-rostral length.

Remarks – This species has to be transferred to *Metaverruca* due to the presence of a large myophore. *Metaverruca cornuta* is known from the Azores (AURIVILLIUS, 1898; GRUVEL, 1920). The present record is in the same area where it was recorded previously (Fig.28).

TABLE 5

NUMBER OF ARTICLES OF CIRRI AND CAUDAL APPENDAGES OF *METAVERRUCA CORNUTA*

	CI	CII	CIII	CIV	CV	CVI	CA
RC	10/10	8/12	15/19	20/22	25/28	25/24	8
LC	9/10	8/12	15/18	21/23	22/25	27/27	+

(CI-VI) cirri I to VI; (CA) caudal appendage; (RC) right cirri; (LC) left cirri; (+) broken ramus.

Suborder Balanomorpha Pilsbry, 1916
Superfamily Pachylasmatoidea Utinomi, 1968
Family Pachylasmatidae Utinomi, 1968
Genus *Pachylasma* Darwin, 1854
Pachylasma giganteum (Philippi, 1836)
(Fig.31)

Chthamalus giganteus Phillipi, 1836:250.

Pachylasma giganteum: DARWIN, 1854:477, pl.19, fig.5a-d; WELTNER, 1897:273; GRUVEL, 1907a:104, fig.218; PILSBRY, 1916:329; STUBBINGS, 1967:263; RELINI, 1969:170; NEWMAN & ROSS, 1976:40; RELINI, 1980:49; FOSTER & BUCKERIDGE, 1995a:183, fig.16A-B.

Material – Eastern Atlantic. 30°08.3'N, 28°20.0'W, 630-520m, shell fragments and one scutum, SM; 30°03.0'N, 28°40.0'W, 450-505m, shell fragment; 29°58'N, 28°20'W, 318-418m, 3 spec and shell fragments and one scutum, SM. Josephine Bank: St. 9c, KD-39, no latitude, pieces of shell and 1 scutum, SM.

Remarks – *P. giganteum* was first described as a fossil from Messina, Italy (PHILIPPI, 1836) and later recorded as extant by DARWIN (1854). He reported this Mediterranean species in (DARWIN, 1854:477) "deep water often attached to the *Millepora aspera*, and sometimes associated with *B. tulipiformis*".

RELINI (1980) recorded this species from southern Italy from 150 to 250m. FOSTER & BUCKERIDGE (1995a) reported *P. giganteum* at Gibraltar between 285 and 864m. The present material came from 318 to 630m (Fig.31). and them range from 15mm to 23mm in carino-rostral length.

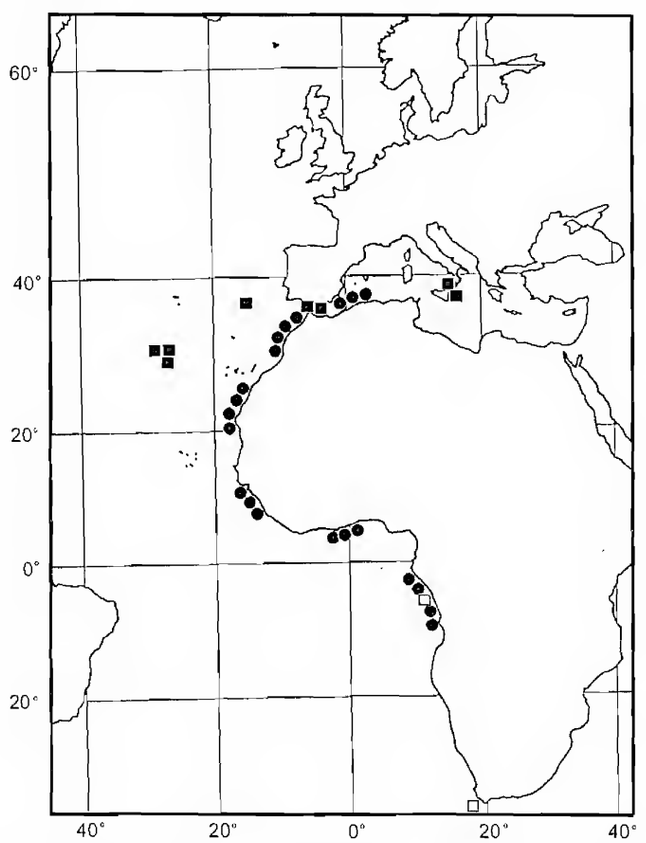

Fig.31- Geographic distribution: (■) *Pachylasma giganteum* (Philippi) – (□) (questionable records), (●) *Solidobalanus (Hesperibalanus) falax* (Broch).

GRUVEL (1907a) recorded *P. giganteum* from Cape of Good Hope (South Africa) attached to rocks with *Mytilus* at shallow depths. KOLOSVÁRY (1942) tentatively recorded this species from the Congo at 12.8m, based on empty shells attached to coral stems. These records suggest an east Atlantic distribution, but it is doubtful that these are valid records. BARNARD (1924), in his monograph on South African barnacles, did not mention the presence of this species. The studies by STUBBINGS (1961a,b; 1963; 1964a,b; 1967) from the Congo and neighboring countries also failed to record this species. GRUVEL (1907a) and KOLOSVÁRY (1942) did not figure or describe the specimens they reported.

Most of my samples represent disarticulated plates and only one sample from the Great Meteor Bank consisted of three entire specimens. Many of the plates were attached to the skeleton of a glass-sponge.

Superfamily Balanoidea Leach, 1817
Family Balanidae Leach, 1817
Subfamily Archaeobalaninae Newman & Ross, 1976
Genus *Solidobalanus* Hoek, 1913
Solidobalanus (Hesperibalanus) fallax (Broch, 1927)
(Fig.31)

Balanus (Hesperibalanus) fallax Broch, 1927:26, pl.2, figs.12-17, pl.3, figs.18-19, text-figs.VII-IX.

Balanus (Hesperibalanus) fallax: NILSSON-CANTELL, 1939:93; UTINOMI, 1959a:402, fig.I; BASSINDALE, 1961:485; STUBBINGS, 1963: 30, figs.10-11; 1964b:342; 1965:892; 1967: 287, figs.19-20; HENRY & MCLAUGHLIN, 1967:47; BARNES & KLEPAL, 1971:86, fig.6; NEWMAN & ROSS, 1976:51.

Balanus (Solidobalanus) occidentalis Stubbings, 1961a:34, figs.8-10.

Balanus (Solidobalanus) occidentalis: STUBBINGS; 1961b:189; 1963:30; BARNES & KLEPAL, 1971:86, fig.6.

Material – Eastern Atlantic. St. M36-118 UD17, Meteor seamounts, without detailed locality, 43 spec and shells, SM; M36-UD 115, Meteor seamounts, without detailed locality, 37 spec and shells, SM.

Remarks – This small species occurs commonly on other barnacles, especially *Megabalanus tulipiformis* and *Balanus spongicola*. *S. fallax* is widespread along the coast of Tropical West Africa (Fig.31) (STUBBINGS, 1967).

The specimens ranged from a few millimeters to 6mm in carino-rostral length.

Family Pyrgomatidae Gray, 1825
Subfamily Megatrematinae Holthuis, 1992
Genus *Megatrema* Sowerby, 1823
Megatrema anglicum (Sowerby, 1823)

Pyrgoma anglica Sowerby, 1823:no pagination, fig.7.

Material – Eastern Atlantic. St. M36, ES162, Meteor seamounts, without detailed locality 1 shell, SM.

Remarks – *M. anglicum*, a symbiont of ahermatypic corals, occurs commonly along the eastern Atlantic (REES, 1962; 1966; STUBBINGS, 1967). Its distribution was presented in detail by REES (1962) and STUBBINGS (1967).

The specimen had a carino-rostral length of 8mm.

Family Balanidae Leach, 1817
Subfamily Balaninae Leach, 1817
Genus *Balanus* Costa, 1778
Balanus spongicola Brown, 1844
(Fig.32)

Balanus spongicola Brown, 1844:121, pl.53, fig.14-16.

Balanus spongicola: DARWIN, 1854:225, pl.IV, figs.1a-d – in part; not *Balanus spongicola var.* from West Indies = *Balanus calidus* Pilsbry, 1916 –; WELTNER, 1898:12; GRUVEL, 1905:225, fig.251; 1909:225; HOEK, 1909:271; PILSBRY, 1916:115, pl.25, figs.2-4c; GRUVEL, 1920:53; BARNARD, 1924:69; NILSSON-CANTELL, 1927:784; KOLOSVÁRY, 1951:412; STUBBINGS, 1961a:32; 1961b:188; 1963:22; 1964b:327; 1967:268; NEWMAN & ROSS, 1976:66; YOUNG, 1994:15, fig.8; 1995:230.

?*Balanus spongicola*: WELTNER, 1897:263; GRUVEL, 1907b:164; KOLOSVÁRY, 1943:87.

Balanus dolfussi Broch, 1927:23, pl.III, fig.20-24.

Balanus dolfussi: NILSSON-CANTELL, 1938b:180; 1939:93.

Material – Eastern Atlantic. 36°42.1'N, 11°09.0'W, 72m, 3 shells, SM; 37°14.7'N, 09°01.5'W, 114-117m, 2 spec, SM; 37°20.4'N, 09°01.5'W, 140-145m, 1 spec and shell fragments, SM. St. M36, ES162, Meteor seamounts, without detailed locality, 14 spec and shells, SM; St. M36-118 UD17, Meteor seamounts, without detailed locality, 13 spec, SM; St. M36-107, ES 162, Meteor seamounts, without detailed locality, 2 spec and shells, SM; St. M36-UD 115, Meteor seamounts, without detailed locality, 5 spec and shells, SM; St. BG502, 36-94, ES141, Meteor seamounts, without detailed locality 1 spec, SM.

Remarks – *B. spongicola* was the most common species of balanomorph sampled, and it was usually found with *B. trigonus* and *M. tulipiformis*. The specimens ranged from a few millimeters to 18mm in carino-rostral length.

B. spongicola was recorded in the Eastern Atlantic from Ireland (Dublin Bay) and South England to South Africa (DARWIN, 1854; PILSBRY, 1916; BARNARD, 1924; STUBBINGS, 1963) and also the southwestern Atlantic (YOUNG, 1994; 1995). It has also been recorded from Venezuela (WELTNER, 1897), Seychelles (GRUVEL, 1907b; KOLOSVÁRY, 1943), Indo-Malaysia (GRUVEL, 1907b) and the Pacific coast of San Salvador (KOLOSVÁRY, 1943) (Fig.32) - all these records have to be reconfirmed.

WELTNER (1898) did not include the Venezuela record for *B. spongicola*, as he did earlier in 1897. The West Indian variety of *Balanus spongicola* described by DARWIN (1854) has proved to be *Balanus calidus* Pilsbry, 1916 according to PILSBRY (1916).

Balanus trigonus Darwin, 1854

Balanus trigonus Darwin, 1854:223, pl.3, fig.7a-f.

Balanus trigonus: PILSBRY, 1916:111, pl.26, figs.1-13e (synonymy).

Material – Eastern Atlantic. St. M36-107, ES 162, Meteor seamounts, without detailed locality, 8 spec and shells, SM; St. M36-KD 115, Meteor seamounts, without detailed locality, 18.3.75, 1 spec, SM; St. M36-118, UD17, Meteor seamounts, without detailed locality, 25 spec, SM; St. M36, ES162, Meteor seamounts, without detailed locality, 13 spec and shells, SM.

Remarks – *B. trigonus* is a common circumtropical and subtropical species usually found fouling ships, marine structures and turtles. It is widespread in the Eastern Atlantic, occurring from the African coast of the Mediterranean to South Africa (STUBBINGS, 1967). ZULLO (1992) inferred that this species was introduced into the Atlantic due to the lack of records of this species there, and also from the lack of fossil records along the Atlantic coasts. The present specimens ranged from a few millimeters to 18mm in carino-rostral length.

Subfamily Megabalaninae Newman, 1979
Genus *Megabalanus* Hoek, 1913
Megabalanus tulipiformis (Ellis, 1758)
(Fig.33)

Lepades Sessiles Balani dietae *Tulipiformis* Ellis, 1758:851, fig.10.

Balanus tulipiformis: DARWIN, 1854:204; pl.II, fig.2a-d; GRUVEL, 1903:128; 1905:216, fig.236; 1912b:350; 1920:53; KOLOSVÁRY, 1943:81; 1951:411; STUBBINGS, 1961a:21; 1961b:187; SOUTHWARD & CRISP, 1963:28, fig.12; STUBBINGS, 1963:14; 1964a:108; 1964b:337; 1965:886; 1967:266; RELINI, 1969:171.

?*Balanus tulipiformis:* GRUVEL, 1907b:164.

Balanus (Megabalanus) tulipiformis: NILSSON-CANTELL, 1921:308, fig.63; 1931:108; UTINOMI, 1959b:382.

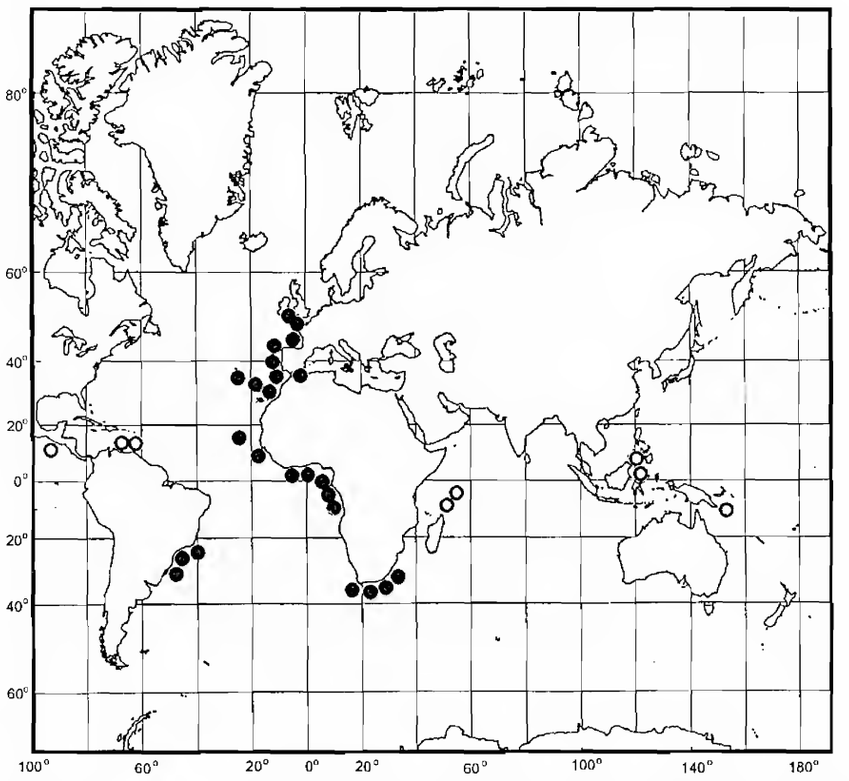

Fig.32- Geographic distribution: (●) *Balanus spongicola* Brown – (○) (questionable records).

Balanus tulipformis (*sic*): GAULD, 1957:10.
Megabalanus tulipiformis: NEWMAN & ROSS, 1976:69; RELINI, 1980:53, pl.IV.

Material – Eastern Atlantic. St. M36-107, ES 162, Meteor seamounts, without detailed locality, 1 spec and shells, SM; St. M36-118 UD17, Meteor seamounts, without detailed locality, 11 spec, SM.

Remarks – *M. tulipiformis* occurs subtidally between 40 and 250m in the Mediterranean and along the Atlantic coast from France to Angola. There is also one record of this species for Wasin, British East Africa, from 18m (GRUVEL, 1907b), which has yet to be reconfirmed (Fig.33). The specimens ranged from 16 to 26mm in rostro-carinal length.

GENERAL DISCUSSION ON DEPTH DISTRIBUTION

The samples obtained by the Meteor Expeditions coupled with data from the literature, permits a general discussion about the depth distribution of the species reported here. Figure 34 summarizes the depth range of the species studied herein. The change in faunal diversity with depth (NEWMAN, 1979; LAGUNA, 1990; YOUNG, 1995) (Fig.35) suggests three groups. The first includes the shallow water species found along the continental shelf to depths of 200 meters (Fig.36) and evidenced by the large peak at 200m.

The peak shown at 3000m (Fig.35) indicates a abyssal group of species which occur below 2500m.

Between these groups, there is the large bathyal group. There is also another peak at 1500m (Fig.35), but when compared with the depth range shown in figure 34, it appears that this peak originates by elimination of some shallower species. Only *V. parazelandiae* occurs only between 1500 and 3000m.

A transition zone occurs between 100 and 250m for the shallow water and bathyal species. There is also a transition zone between 2000 and 3000m for the bathyal and the abyssal species (Figs.34, 36).

Similarly, YOUNG (1995) found that along the Brazilian coast, there is a substitution of shallow water species by bathyal species at depths of about 100m. Therefore, the shallow tropical species present a narrower depth range (100m), when compared with the shallow temperate species depth range (200m).

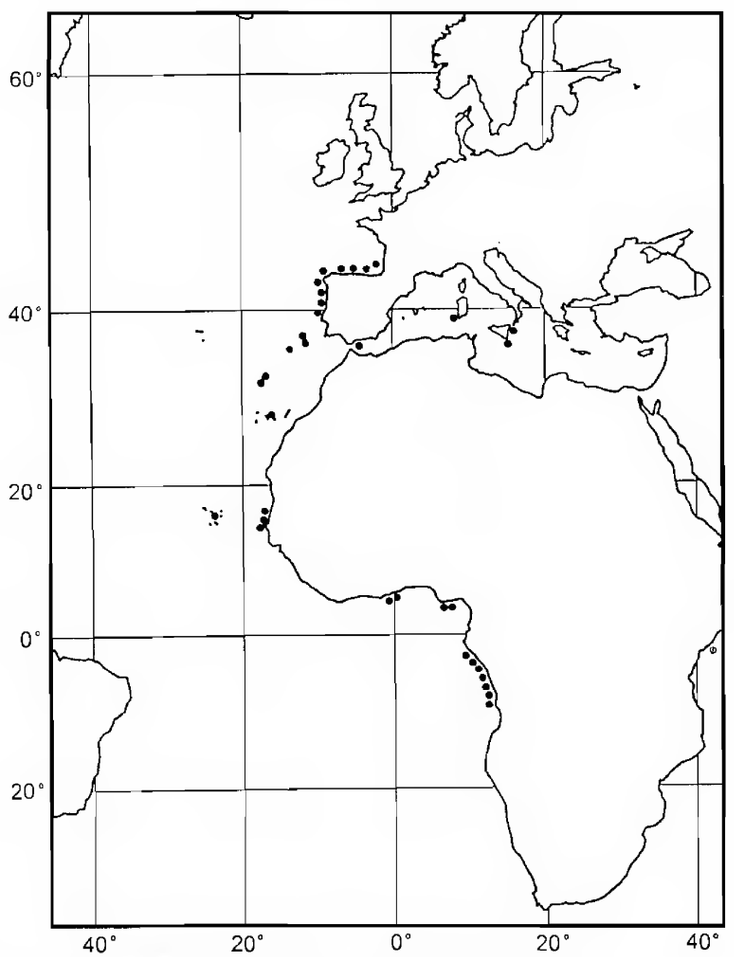

Fig.33- Geographic distribution: (●) *Megabalanus tulipiformis* (Ellis).

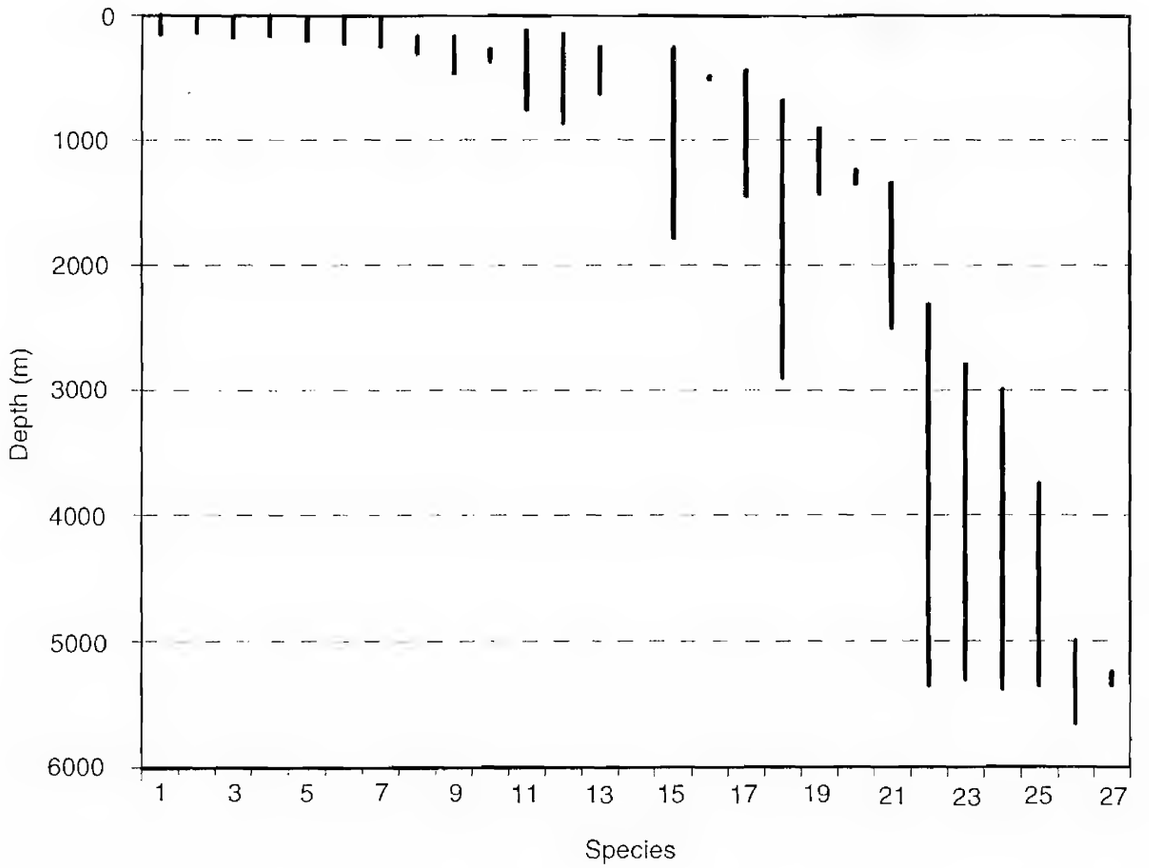

Fig.34- Depth range along the eastern Atlantic of the species collected by "Meteor": 1) *B. trigonus*, 2) *B. spongicola*, 3) *V. stroemia*, 4) *M. anglicum*, 5) *S. scalpellum*, 6) *S. fallax*, 7) *M. tulipiformis*, 8) *O. patens*, 9) *A. falcata*, 10) *P. aurantia*, 11) *H. cornuta*; 12) *P. giganteum*, 13) *H. microstoma*, 14) *G. pilsbryi*, 15) *M. recta*, 16) *M. sensibilis*, 17) *M. cornuta*, 18) *A. michelottianum*, 19) *A. tritonis*, 20) *D. thieli*, 21) *V. parazelandiae*, 22) *N. debile*, 23) *T. regium*, 24) *A. rigidum*, 25) *T. ovale*, 26) *P. limpidus*, 27) *L. meteoria*.

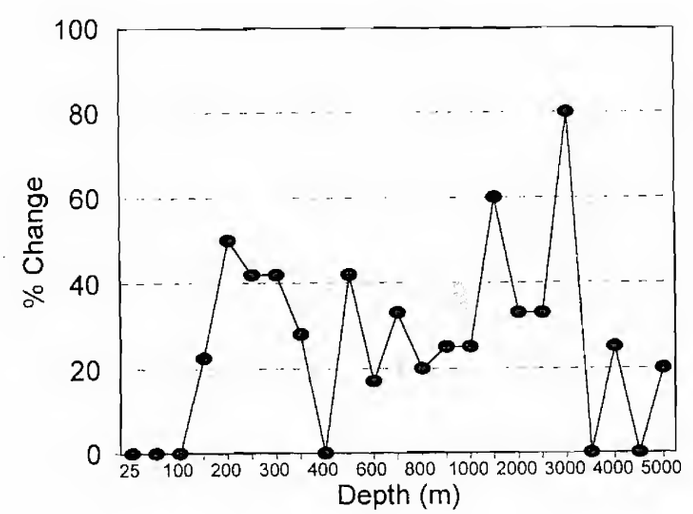

Fig.35- Percent of change of species composition by depth gradient.

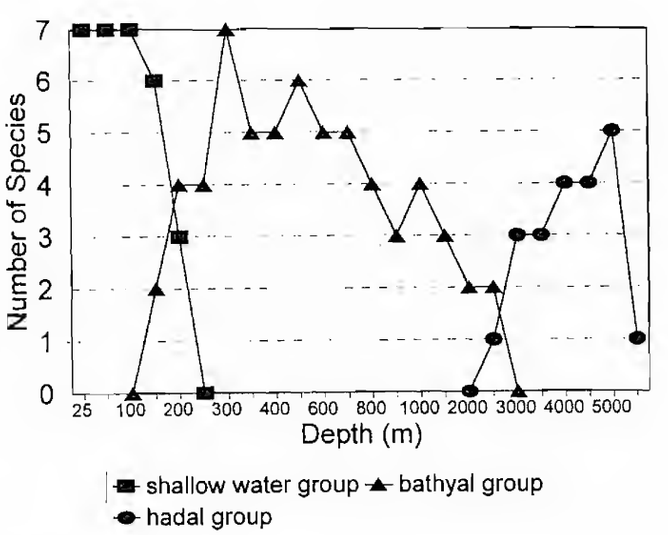

Fig.36- Species richness of the three groups of species along a depth gradient.

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ABSTRACT

The "F.S. Meteor" made numerous dredges off the European and North African coasts, from the continental shelf to the abyssal plain. Thirty species were collected: *Oxynaspis patens* Aurivillius, *Poecilasma aurantia* Darwin, *Lepas anatifera* Linnaeus, *Conchoderma auritum* (Linnaeus), *Heteralepas microstoma* (Gruvel), *H. cornuta* (Darwin), *Gruvelialepas pilsbryi* (Gruvel), *Aurivillialepas falcata* (Aurivillius), *Pollicipes pollicipes* (Gmelin), *Scalpellum scalpellum* (Linnaeus), *Neoscalpellum debile* (Aurivillius), *Arcoscalpellum michelottianum* (Seguenza), *A. tritonis* (Hoek), *Planoscalpellum limpidus* (Zevina), *Amigdoscalpellum rigidum* (Aurivillius), *Trianguloscalpellum regium* (Wyville-Thomson), *T. ovale* (Hoek), *Verruca stroemia* (Müller), *M. recta* Aurivillius, *M. cornuta* Aurivillius, *Pachylasma giganteum* (Philippi), *Solidobalanus (Hesperibalanus) fallax* (Broch), *Megatrema anglicum* (Sowerby), *Balanus spongicola* Brown, *B. trigonus* Darwin and, *Megabalanus tulipiformis* (Ellis); including four new species, *Dichelaspis thieli* n.sp., *Litoscalpellum meteoria* n.sp., *Verum parazelandiae* n.sp. and, *Metaverruca sensibilis* n.sp.

The large-size species of *Trianguloscalpellum* (*T. regium* (Wyville-Thomson), *T. darwinii* (Hoek),*T. gigas* (Hoek) and, *T. ovale* (Hoek)) are redescribed and their generic status is discussed. A key for the "large" scalpellids from the Atlantic and certain related Pacific species is presented.

Three groups of species were observed along a depth gradient: a shallow-water species group occurring from the surface to 250m, a bathyal species group from 100m to 3000m, and a abyssal species group deeper than 2000m.

Key words: Crustacea, Cirripedia, *Dichelaspis* n.sp., *Litoscalpellum* n.sp., *Verum* n.sp., *Metaverruca* n.sp., Eastern Atlantic, Taxonomy, Biogeography.

RESUMO

CIRRIPEDIA (CRUSTACEA) COLETADOS PELO "FISHERIES STEAMER METEOR" NO ATLÂNTICO ORIENTAL

O "F.S. Meteor" realizou diversas dragagens ao largo das costas da Europa e África do Norte desde a plataforma continental até a planície abissal. Trinta espécies foram coletadas: *Oxynaspis patens* Aurivillius, *Poecilasma aurantia* Darwin, *Lepas anatifera* Linnaeus, *Conchoderma auritum* (Linnaeus), *Heteralepas microstoma* (Gruvel), *H. cornuta* (Darwin), *Gruvelialepas pilsbryi* (Gruvel), *Aurivillialepas falcata* (Aurivillius), *Pollicipes pollicipes* (Gmelin), *Scalpellum scalpellum* (Linnaeus), *Neoscalpellum debile* (Aurivillius), *Arcoscalpellum michelottianum* (Seguenza), *A. tritonis* (Hoek), *Planoscalpellum limpidus* (Zevina), *Amigdoscalpellum rigidum* (Aurivillius), *Trianguloscalpellum regium* (Wyville-Thomson), *T. ovale* (Hoek), *Verruca stroemia* (Müller), *M. recta* Aurivillius, *M. cornuta* Aurivillius, *Pachylasma giganteum* (Philippi), *Solidobalanus (Hesperibalanus) fallax* (Broch), *Megatrema anglicum* (Sowerby), *Balanus spongicola* Brown, *B. trigonus* Darwin e *Megabalanus tulipiformis* (Ellis); incluindo quatro novas espécies, *Dichelaspis thieli* n.sp., *Litoscalpellum meteoria* n.sp., *Verum parazelandiae* n.sp. e *Metaverruca sensibilis* n.sp.

As espécies de grande porte de *Trianguloscalpellum* (*T. regium* (Wyville-Thomson), *T. darwinii* (Hoek), *T. gigas* (Hoek) e *T. ovale* (Hoek)) são redescritas e seu *status* genérico é discutido. Uma chave para as espécies "grandes" de Scalpellidae do Atlântico e as espécies relacionadas do Pacífico é apresentada.

Três grupos de espécies foram observados ao longo de um gradiente de profundidade: um de águas rasas ocorrendo da superfície até 250m, um batial ocorrendo de 100m até 3000m e outro abissal ocorrendo abaixo dos 2000m.

Palavras-chave: Crustacea, Cirripedia, *Dichelaspis* sp.n., *Litoscalpellum* sp.n., *Verum* sp.n., *Metaverruca* sp.n., Atlântico Oriental, Taxonomia, Biogeografia.

LITERATURE CITED

ANDERSON, D.T., 1980 – Cirral activity and feeding in the Verrucomorph barnacles *Verruca recta* Aurivillius and *V. stroemia* (O.F.Müller) (Cirripedia). **J. mar. biol. Ass. U.K.**, Plymouth, **60**:349-366.

ANNANDALE, N., 1909 – An account of the Indian Cirripedia Pedunculata. Part I. Family Lepadidae (*sensu stricto*). **Mem. Indian Mus.**, Calcutta, **2**:61-137, pls. VI-VII.

AURIVILLIUS, C.W.S., 1894 – Studien über Cirripeden. **K. Svenska Vetensk. Akad. Handl.**, Uppsala, **26**(7):1-107, 9 pls.

AURIVILLIUS, C.W.S., 1898 – Cirrhipèdes nouveaux provenant des Campagnes Scientifiques de S.A.S. le Prince de Monaco. **Bull. Soc. zool. Fr.**, Paris, **23**:189-198.

BARNARD, K.H., 1924 – Contributions to the crustacean fauna of South Africa. Cirripedia. **Ann. S. Afr. Mus.**, Cape Town, **20**(1):1-103.

BARNES, H. & KLEPAL, W., 1971 – The structure of the pedicel of the penis in cirripedes and its relation to other taxonomic characters. **J. exp. mar. Biol. Ecol.**, Amsterdam, **7**:71-94.

BAYER, F.M.; VOSS, G.L. & ROBINS, C.R., 1970 – Cirripedia: A43. Report on the marine fauna and benthic shelf-slope communities of the Isthmian Region. *In*: **Bioenvironmental and radiological-safety feasibility studies Atlantic-Pacific interoceanic canal.** Columbus, Battelle Memorial Institute.

BASSINDALE, R., 1961 – On the marine fauna of Ghana. **Proc. zool. Soc. Lond.**, London, **137**(4):481-510.

BELLOC, G., 1959 – Catalogue des types de Cirrhipèdes du Musée océanographique de Monaco. **Bull. Inst. océanogr.**, Monaco, (1157):1-7.

BROCH, H., 1927 – Studies on Moroccan Cirripeds (Atlantic coast). **Bull. Soc. Sci. nat. Maroc**, Rabat, **7**:11-38.

BROCH, H., 1931 – Papers from Dr. Th. Mortensen's Pacific Expedition. 1914-1916. Indomalayan Cirripedia. **Vidensk. Meddel. Dansk naturh. Foren.**, Copenhagen, **91**:1-146.

BROCH, H., 1953 – Cirripedia Thoracica. **Danish Ingolf-Exped.**, Copenhagen, **3**(14):1-16.

BROWN, T. 1844 – **Illustrations of the recent conchology of Great Britain and Ireland, with the description and localities of all the species, marine, land and fresh-water.** London, Smith, Elder & Co. 144p.

BUCKERIDGE, J.S., 1975 – The significance of Cirripedes to the paleoecology of Motutapu Island. **TANE, J. Auckland Univ. Fld Club**, Auckland, **21**:121-129.

BUCKERIDGE, J.S., 1983 – Fossil barnacles (Cirripedia: Thoracica) of New Zealand and Australia. Paleont. **Bull. N. Zeal. geol. Survey**, Wellington, **50**:1-151, 13pls.

BUCKERIDGE, J.S., 1994 – Cirripedia Thoracica: Verrucomorpha of New Caledonia, Indonesia, Wallis and Futuna Islands. - *In*: CROSNIER, A. (Ed.). Résultats des Campagnes MUSORSTOM, 12. **Mem. Mus. natn. Hist. nat.**, Paris, **161**:87-125.

DARWIN, C., 1852 – **A Monograph on the Subclass Cirripedia, with figures of all the species. The Lepadidae; or pedunculate cirripedes.** London, Ray Society. 400p., 10pls.

DARWIN, C., 1854 – **A Monograph on the Subclass Cirripedia, with figures of all the species. The Balanidae, the Verrucidae...** London, Ray Society. 684p.

ELLIS, J., 1758 – An account of several rare species of barnacles. **Philos. Trans.**, London, **50**(2):845-855, 1pl.

FOSTER, B.A., 1978 – The marine fauna of New Zealand: Barnacles (Cirripedia: Thoracica). **Mem. N. Zeal. oceanogr. Inst.**, Wellington, **69**:1-160.

FOSTER, B.A., 1981 – Cirripeds from ocean ridges north of New Zealand. **N. Zeal. J. Zool.**, Wellington, **8**:349-367.

FOSTER, B.A. & BUCKERIDGE, J.S., 1995a – Barnacles (Cirripedia: Thoracica) of seas off the Straits of Gibraltar. **Bull. Mus. natn. Hist. nat., ser. 4**, Paris, **17**:163-191.

FOSTER, B.A. & BUCKERIDGE, J.S., 1995b – Barnacles (Cirripedia: Thoracica) of seas off Réunion Island and East Indies. **Bull. Mus. natn. Hist. nat., ser. 4**, Paris, **16**:345-382.

GAULD, D.T., 1957 – An annotated check-list of the Crustacea of the Gold coast. I. Cirripedia. **J. West African Sci. Assoc.**, London, **3**(1):10-11.

GMELIN, J.F., 1790 – **Systema Naturae sive regna tria naturae systematics proposita per classe, ordine, genera et species, editio decima**

tertia, aucta reformata, cura J.F.Gmelin. Vermes. Leipzig. v.1, n.6, 3021-3910p.

GORDON, J.A., 1970 – An annotated checklist of Hawaiian barnacles (Class Crustacea; Subclass Cirripedia) with notes on their nomenclature, habitats and Hawaiian localities. **Hawaii Inst. Mar. Biol. Tech. Rep.**, Honolulu, **19**:1-130.

GRUVEL, A., 1900a – Sur quelques espèces nouvelles du genre *Scalpellum* provenant des dragages du "Talisman". **Bull. Mus. Hist. nat.**, Paris, **6**:189-194.

GRUVEL, A., 1900b – Sur les espèces nouvelles du genre *Verruca* provenants du "Talisman". **Bull. Mus. Hist. nat.**, Paris, **6**:242-244.

GRUVEL, A., 1901 – Diagnoses de quelques espèces nouvelles de Cirrhipèdes. **Bull. Mus. Hist. Nat.**, Paris, **5**:256-263.

GRUVEL, A., 1902a – Cirrhipèdes. - **Expéditions Scientifiques du "Travailleur" et du "Talisman", pendant les années 1880, 1881, 1882, 1883**. Paris. 178p., pls.1-7.

GRUVEL, A., 1902b – Sur quelques espèces nouveaux de la collection du British Museum. **Trans. Linn. Soc. Lond., ser. 2, Zool.**, London, **8**:277-294, pl.24.

GRUVEL, A., 1903 – Revision des Cirrhipèdes appartenant à la collection du Muséum d'Histoire Naturelle (operculés). **Nouv. Arch. Mus. Hist. nat., ser. 4**, Paris, **5**:95-170, pls.1-4.

GRUVEL, A., 1905 – **Monographie des Cirrhipèdes ou Thecostracés**. Paris, Masson et Cie Éditeurs. 472p.

GRUVEL, A., 1907a – Note préliminaire sur le Cirrhipèdes Operculès recueillis par l'Expèdition Subpolaire Antarctique Allemande du "Gauss". **Bull. Soc. zool. Fr.**, Paris, **32**:104-106.

GRUVEL, A., 1907b – Étude des cirrhipèdes du Musée de Cambridge. **Bull. Soc. zool. Fr.**, Paris, **32**:162-165.

GRUVEL, A., 1909 – Die Cirripedien der Deutschen Südpolar-Expedition 1901-1903. **Deutsche Südpolar-Exped. 1901-1903,** Berlin, **Zool. 11**(3):195-229, pls.23-26.

GRUVEL, A., 1912a – Note préliminaire sur les Cirrhipèdes recueillis pendant les campagnes de S.A.S. le Prince de Monaco. **Bull. Inst. océanogr.**, Monaco (241):1-7.

GRUVEL, A., 1912b – Mission Gruvel sur la côte occidentale d'Afrique (1909-1910) et collection du Muséum d'Histoire Naturelle. Les Cirrhipèdes. **Bull. Mus. Hist. nat.**, Paris, **18**(6):344-350.

GRUVEL, A., 1920 – Cirrhipèdes provenant des campagnes scientifiques de S.A.S. le Prince de Monaco. **Résultats des Campagnes Scientifiques accomplies sur son yacht par Albert Ier, Prince Souverain de Monaco**. Monaco (53):1-89, pls.1-7.

HENRY, D.P. & MCLAUGHLIN, P.A., 1967 – A revision of the subgenus *Solidobalanus* Hoek (Cirripedia: Thoracica) including a description of a new species with complemental males. **Crustaceana**, Leiden, **12**(1):43-58.

HOEK, P.P.C., 1883 – Report on the Cirripedia collected by H.M.S.Challenger during the years 1873-76. **Rept. Sci. Res. Voyage H.M.S. Challenger, Zool., part 25**, London, **8**:1-169, pls.1-13.

HOEK, P.P.C., 1884 – Report on the Cirripedia colected by H.M.S.Challenger during the years 1873-76. Anatomical Part. **Rept. Sci. Res. Voyage H.M.S.Challenger, Zool., part 28**, London, **10**:1-47, pls.1-6.

HOEK, P.P.C., 1907a – The Cirripedia of the Siboga Expedition. A. Cirripedia Pedunculata. **Siboga Exped.**, Leiden, **31**(a):1-127, pls.1-10.

HOEK, P.P.C., 1907b – Cirripedia. Résultats Voyage du S.Y.Belgica, 1897-1899 (Expédition Antarctique Belge). **Rapp. Sci. Zool.**, Anvers, 3-9.

HOEK, P.P.C., 1909 – Die Cirripedien des nordischen Planktons. *In*: BRANDT, K. & APSTEIN, C. (Eds.). **Nordisches Plankton**. Verlag von Lipsius & Tischer, Kiel. v.11, n.8, 265-331p.

HOEK, P.P.C., 1913 – The Cirripedia of the Siboga Expedition. B. Cirripedia Sessilia. **Siboga Exped.**, Leiden, **31**:(b)129-275, pls.11-27.

HOEK, P.P.C., 1914 – Cirripedia. **"Michael Sars" North Atlantic Deep-sea Exped. 1910, Zool.**, **3**:1-6.

KOLOSVÁRY, G., 1942 – Studien an Cirripedien. **Zool. Anz.**, Leipzig, **137**:138-150.

KOLOSVÁRY, G., 1943 – Cirripedia Thoracica in der sammlung des Ungarischen National-Museums. **Ann. Hist. natn. Mus. nat. Hungar.**, Budapest, **36**:67-120.

KOLOSVÁRY, G., 1951 – Les balanides de la M'editerranée. **Acta biol. Acal. Sci. Hungar.**, Budapest, **2**(4):411-413.

KRÜGER, P., 1940 – Cirripedia. *In*: BRONNS, H.G. (Ed.). **Klassen und Ordnungen des Tierreichs**, Leipzig. v.5, n.3, 391p.

LAGUNA, J.G., 1990 – Shore barnacles (Cirripedia, Thoracica) and a revision of their provincialism and transition zones in the Tropical Eastern Pacific. **Bull. mar. Sci.**, Miami, **46**(2):406-424.

LETA, A.C. & YOUNG, P.S., 1996 – First record from the family Oxynaspididae (Crustacea, Cirripedia) from the Southwestern Atlantic. **Nauplius**, Rio Grande, **3**:23-31.

LINNAEUS, C., 1758 – **Systema naturae.** Holmiae, Editio Decima, Reformata. v.1, 824p.

LINNAEUS, C., 1767 – **Systema naturae**. Holmiae, Editio Duodecima, Reformata. v.2, 533-1327p.

MÜLLER, O.F., 1776 – **Zoologiae Danicae Prodomus, seu Animalium Daniae et Norvegiae, indigenarum charactheres, nomina, et synonyma imprimis popularium**. Havniae. i-xxvii, 282p.

NEWMAN, W.A., 1979 – Californian transition zone: Significance of short-range endemics. *In*: GRAY, J. & BOUCOT, A.J. (Eds.). **Historical Biogeography, Plate Tectonics, and the Changing Environment**. Oregon State Univ. Press, Oregon. 399-416p.

NEWMAN, W.A., 1980 – A review of extant *Scillaelepas* (Cirripedia: Scalpellidae) including recognition of new species from the North Atlantic, West Indies and New Zealand. **Tethys**, **9**(4):379-398.

NEWMAN, W.A. & ROSS, A., 1971 – Antarctic Cirripedia. **Antarctic Res. Ser.**, Baltimore, **14**:1-257.

NEWMAN, W.A. & ROSS, A., 1976 – Revision of the balanomorph barnacles; including a catalog of species. **Mem. San Diego Soc. nat. Hist.**, San Diego, **9**:1-108.

NEWMAN, W.A.; ZULLO, V.A. & WITHERS, T.H., 1969 – Cirripedia. *In*: R.C.MOORE (Ed.). **Treatise on Invertebrate Palaeontology, part R, Arthropoda**. Geological Society of America and University of Kansas. v.4, n.1, R206-R295p.

NILSSON-CANTELL, C.A., 1921 – Cirripeden-Studien. Zur kenntnis der Biologie, Anatomie und Systematik dieser Gruppe. **Zool. Bidr. Upps.**, Uppsala, **7**:75-395, 3 pls.

NILSSON-CANTELL, C.A., 1927 – Some barnacles in the British Museum (Nat. Hist.). **Proc. zool. Soc. Lond.**, London, 743-790, 1 pl.

NILSSON-CANTELL, C.A., 1928 – Studies on cirripedes in the British Museum (Nat. Hist.). **Ann. Mag. nat. Hist., ser. 10**, London, **2**(7):1-39.

NILSSON-CANTELL, C.A., 1929 – Cirripedien des genus *Verruca* der Deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899. **Zool. Jahrb.**, Jena, **58**:459-480.

NILSSON-CANTELL, C.A., 1931 – Revision der Sammlung recenter Cirripedien des Naturhistorischen Museums in Basel. **Verh. naturf. Ges. Basel**, Basel, **42**:103-137.

NILSSON-CANTELL, C.A., 1938a – Cirripedes from the Indian Ocean in the collection of the Indian Museum, Calcutta. **Mem. ind. Mus.**, Calcutta, **13**(1):1-81, 3 pls.

NILSSON-CANTELL, C.A., 1938b – Recent cirripeds from the Congo. **Rev. Zool. Bot. Afr.**, Bruxelles, **21**(1):175-181.

NILSSON-CANTELL, C.A., 1939 – Résultats Scientifiques des croisères du Navire-école Belge "Mercator". **Mém. Mus. R. Hist. Nat. Belg., ser. 2**, Bruxelles, **2**(15):91-94.

NILSSON-CANTELL, C.A., 1955 – Cirripedia. **Rept. Swedish Deep-Sea Exped.**, Göteborg, **Zool. 2**(17):215-220.

NILSSON-CANTELL, C.A., 1978 – Cirripedia Thoracica and Acrothoracica. **Marine Invertebrates of Scandinavia**, Oslo. v.5, 135p.

PHILLIPI, R.A., 1836 – Cirripedia. *In*: **Enumeratio Molluscorum Sicilaecum viventium in tellure tertiaria fossilium quae in itinere suo observati**, Berolini. 267p.

PILSBRY, H.A., 1907a – The barnacles (Cirripedia) contained in the collections of the U. S. National Museum. **Bull U. S. natn. Mus.**, Washington, **60**:1-122, 11 pls.

PILSBRY, H.A., 1907b – Hawaiian Cirripedia. **Bull. Bur. Fish.**, Washington, **26**:181-204, pls.6-11.

PILSBRY, H.A., 1916 – The sessile barnacles (Cirripedia) contained in the collections of the U. S. National Museum; including a Monograph of the American species. **Bull. U. S. natn. Mus.**, Washington, **93**:1-366.

REES. W.J., 1962 – The distribution of the coral, *Caryophyllia smithii* and the barnacle *Pyrgoma anglicum* in British waters. **Bull. Brit. Mus. (Nat. Hist.), Zool.**, London, **8**(9):403-418, pl.12.

REES. W.J., 1966 – Further notes on the distribution of *Caryophyllia smithii* Stokes & Broderip and *Pyrgoma anglicum* Sowerby. **Ann. Mag. Nat. Hist., ser. 13**, London, **9**:289-292.

RELINI, G., 1969 – La distribuzione dei Cirripedi Toracici nei mari Italiana. **Arch. bot. Biogeogr. ital., ser 4, 45**(4):168-186.

RELINI, G., 1980 – **Guide per il riconoscimento delle specie animali delle acque Lagunari e costiere italiane. Cirripedi Toracici**. Consiglio Nazionale delle Ricerche, Genova. v.2, 122p.

REN, X., 1984 – Studiens on Chinese Cirripedia (Crustacea). IV. Family Verrucidae. **Stud. mar. sin.**, (23):165-179, pls.1-2 [in chinese].

REN, X., 1989 – On a collection of Cirripedia Thoracica from Madagascar and adjacent waters. **Bull. Mus. natn. Hist. nat., 4 ser., sect. A**, Paris, **2**:431-468.

ROSELL, N.C., 1981 – Crustacea: Cirripedia. **Résultats des Campagnes MUSORSTOM, Mém. Mus. natn. Hist. nat.**, Paris, **1**(12):277-307.

ROSELL, N.C., 1991 – Crustacea Cirripedia Thoracica: Musorstom. Phillipines collection. **Résultats des Campagnes MUSORSTOM, Mém. Mus. natn. Hist. nat.**, Paris, **9**(1):9-61.

ROSS, A., 1975 – *Heteralepas cornuta* (DARWIN) in the eastern Pacific abyssal fauna (Cirripedia, Thoracica). **Crustaceana**, Leiden, **28**(1):17-20.

ROSS, A.; CERAME-VIVAS, M.J. & MCCLOSKEY, L.R., 1964 – New barnacle records for the coast of North Carolina. **Crustaceana**, Leiden, **7**(4):312-313.

SCHUMACHER, C.F., 1817 – **Essai d'un nouveau systeme des havitations des vers testaces**, Copenhagen. 287p.

SEGUENZA, G., 1876 – Ricerche paleontologiche intorno ai Cirripedi Terziarii della Provincia di Messina. Parte II. Terza famiglia Lepadidi Darwin. **Atti Dell'Accademia Pontoniana**, **10**:369-481, pls.6-10.

SOWERBY, G.B., 1823 – **The genera of Recent and fossil shells, for the use of students in Conchology and Geology, with original plates by J.D.C.Sowerby (xviii)**. E.J.Stirling, London, no pagination.

SOUTHWARD, A.J. & CRISP, D.J., 1963 – Barnacles of European waters. **Catalogue of main marine fouling organisms 1, Barnacles**. Organisation for Economic Co-operation and Development Publ., Paris. 46p.

SOUTHWARD, A.J. & SOUTHWARD, E.C., 1958 – On the occurrence and behaviour of two little-known barnacles, *Hexelasma hirsutum* and *Verruca recta*, from the continental slope. **J. mar. biol. Ass. U.K.**, Plymouth, **37**:633-647.

STUBBINGS, H.G., 1936 – Cirripedia. **John Murray Exped., Sci. Rept., Zool.**, London, **4**(1):1-70.

STUBBINGS, H.G., 1961a – Cirripedia Thoracica from tropical West Africa. **Atlant. Rep.**, Copenhagen, **6**:7-41.

STUBBINGS, H.G., 1961b – Cirripedia. Campagne de la "Calypso" dans le Golfe de Guineè et aux iles Principes, São Tomé, Annobon (1956). **Ann. Inst. oceanogr.**, Monaco, **37**:179-192.

STUBBINGS, H.G. 1963 – Cirripedia of the tropical South Atlantic coast of Africa. **Résult. Sci. Expéd. océanogr. belg. eaux côtières Afr. l'Atlantique Sud (1948-1949), Inst. R. Sci. nat. Belg.** Bruxelles, **3**(10):1-39.

STUBBINGS, H.G., 1964a – Cirripedia. Campagnes de la "Calypso": Iles du Cap Vert. **Ann. Inst. océanogr.**, Monaco, **41**:103-112.

STUBBINGS, H.G., 1964b – Cirripedia from the Congo estuary and adjacent coasts in the Musée Royal de l'Afrique Centrale, Tervurem, Belgium. **Rev. Zool. Bot. Afr.**, Bruxelles, **69**(3-4):327-347.

STUBBINGS, H.G., 1965 – West African Cirripedia in the collections of the Institut Français d'Afrique Noire, Dakar, Senegal. **Bull. Inst. fr. Afr. noire, ser A**, Paris, **27**(3):876-907.

STUBBINGS, H.G., 1967 – The cirriped fauna of tropical West Africa. **Bull. Br. Mus. Nat. Hist., Zool.**, London, **15**(6):229-319, 1 pl.

TOTTON, A.K., 1940 – New species of the Cirripede genus *Oxynaspis*, commensal with Antipatharia. **Ann. Mag. Nat. Hist. 6, ser. 11**, London, **36**:465-486.

UTINOMI, H., 1959a – Cirripedia Thoracica from the Western Mediterranean. Resultats de Campagnes du "Professeur Lacaze-Duthiers". (I. Algerie, 1952). **Vie Milieu**, Paris, **10**(4):400-404.

UTINOMI, H., 1959b – Thoracic Cirripeds from the environs of Banyuls. **Vie Milieu**, Paris, **10**(4):379-399.

WEISBORD, N.E., 1979 – Lepadomorph and Verrucomorph barnacles (Cirripedia) of Florida and adjacent waters, with an addendum on the Rhizocephala. **Bull. Am. Paleont.**, Ithaca, **76**(306):1-156.

WELTNER, W., 1897 – Verzeichnis der bisher beschriebenen recenten Cirripedienarten. Mit Angabe der im berliner Museum vorhandenen Species und ihrer Fundorte. **Arch. Naturgesch.**, Berlin, **1**(3):227-280.

WELTNER, W., 1898 – Cirripedien. **Ergebn. Hamburger Magalhaensische Sammelreise**, Hamburg, **4**:1-15.

WELTNER, W., 1922 – Cirripedia der Deutschen Tiefsee-Expedition. **Wiss. Ergebn. dt. Tiefsee-Exped. "Valdivia"**, Jena (2):1-54, pls.II-IV.

WYVILLE-THOMSON, C.W., 1873 – Notes from the "Challenger". **Nature**, London, **8**:347-349.

WYVILLE-THOMSON, C.W., 1877 – **The Voyage of the "Challenger". The Atlantic**, Macmillan and Co, London. v.2, 396p.

YOUNG, P.S., 1994 – Superfamily Balanoidea Leach (Cirripedia, Balanomorpha) from the Brazilian coast. **Bol. Mus. Nac., N.S., Zool.**, Rio de Janeiro (356):1-36.

YOUNG, P.S., 1995 – New interpretations of South American patterns of barnacle distribution. *In*: SCHRAM, F.R & HOEG, J. (Eds.). **New Frontiers in Barnacle Evolution. Crustacean issues.** Rotterdam. v.10, 229-253p.

ZEVINA, G.B., 1969 – Cirripedia Thoracica. *In*: KORT, V.G. (Ed.). **The biology of the Pacific Ocean. Deep sea botton fauna**. Inst. Okeanol. Akad. Sci. USSR, Moscow. v.2, n.1, 66-68p. [in russian].

ZEVINA, G.B., 1970 – Fauna of Kurilo-Kamchastkogo Trench. **Trudy Inst. Okeanol.**, Moscow, **86**:252-276 [in russian].

ZEVINA, G.B., 1972 – Benthic Lepadomorpha (Cirripedia Thoracica) from the Southeast Pacific. **Crustaceana**, Leiden, **22**(1):39-63.

ZEVINA, G.B., 1973 – Scalpellids (Scalpellidae, Cirripedia) from Alaska. **Trudy Inst. Okeanol.**, Moscow, **91**:136-140 [in russian].

ZEVINA, G.B., 1976 – Abyssal species of barnacles (Cirripedia, Thoracica) of the North Atlantic. **Zool. Zh.**, Moscow, **55**(8):1149-1156 [in russian].

ZEVINA, G.B., 1978 – A new system of the family Scalpellidae Pislbry (Cirripedia, Thoracica). 2. Subfamilies Arcoscalpellinae and Meroscalpellinae. **Zool. Zh.**, Moscow, **9**:1343-1352 [in russian].

ZEVINA, G.B., 1981a – Barnacles of the suborder Lepadomorpha of the world ocean. I. Family Scalpellidae. **Fauna U.S.S.R., Zool. Inst. Acad. Sci. USSR**, Leningrad, **127**:1-406 [in russian].

ZEVINA, G.B., 1981b – Deep-sea Cirripedia of the Australian and New Zealand waters. **Trudy Inst. Okeanol.**, Moscow, **115**:76-93 [in russian].

ZEVINA, G.B., 1982 – Barnacles of the suborder Lepadomorpha of the world ocean. II. **Fauna U.S.S.R., Zool. Inst. Acad. Sci. USSR**, Leningrad, **133**:1-222 [in russian].

ZEVINA, G.B., 1987a – Deep-Sea Verrucomorpha (Cirripedia, Thoracica) of the Pacific. 1. The North Pacific. **Zool. Zh.**, Moscow, **66**(12):1812-1821 [in russian].

ZEVINA, G.B., 1987b – Abyssal Cirripedia Verrucomorpha (Thoracica) of the Atlantic and Indian Ocean. **Zool. Zh.**, Moscow, **66**(9):1304-1313 [in russian].

ZEVINA, G.B., 1993 – Abyssal species of Scalpellidae (Cirripedia, Thoracica) in the Atlantic region of the Antarctic. **Trudy Inst. Okeanol.**, Moscow, **127**:122-128 [in russian].

ZULLO, V.A., 1968 – Catalog of the Cirripedia named by Henry A. Pilsbry. **Proc. Acad. natn. Sci. Philad.**, Philadelphia, **120**(5):209-235.

ZULLO, V.A., 1992 – *Balanus trigonus* Darwin (Cirripedia, Balanidae) in the Atlantic Basin: An introduced species?. **Bull. mar. Sci.**, Miami, **50**(1):66-74.

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